Australia 85c South Africa 80c New Zealand 85c Malaysia $2.25

PRACTICAL
ELECTRONICS
NOVEMBER 1978

50p

FEB 1979

MOON LANDING GAME

SPECIAL!

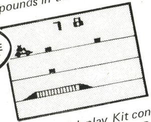
CAR DEVICES
8 PAGE SUPPLEMENT

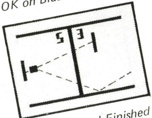
2 Soldering Iron Offers

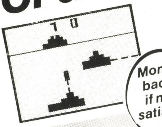
Teleplay presents the PROGRAMAGAME of all time!

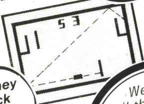
TELEPLAY have produced a new product of easy to assemble cartridge games, for you and all your family, that will not go out of date. Just ADD each new cartridge, as it becomes available, and your colour video centre will be up to date the Teleplay way. You will save pounds in the long run. Works OK on Black and White TV.

EX-STOCK IMMEDIATE DELIVERY





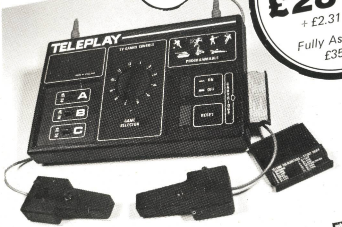




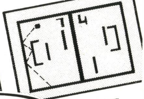
Money back if not satisfied

We offer all this to you for ONLY **£28·90** + £2.31 VAT

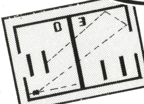
Fully Assembled £35.90

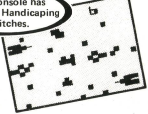


The Teleplay Kit consists of a Professional Finished Inject Moulded Box – Joystick Hand Controls – one cartridge which consists of 10 games – Football, Tennis, Solo Squash (1 & 2 players), Hockey, Basketball (1 & 2 players), Shoot etc. Mains Adaptor. All holes are pre-drilled – No Special equipment required. You'll be surprised how easy it is to assemble this professional kit! Instruction Manual supplied separately at 0.45p. TELEPLAY GIVES YOU TWICE THE FUN BUILDING AND PLAYING THE MOST PROFESSIONAL TV GAME KIT EVER OFFERED.

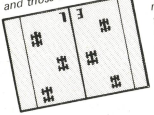


Main Console has 3 Facility Handicaping Switches.





Every 3 months a NEW game will become available to you and those already under production include Submarines, Space War, Wipe Out and many more. The price of these will vary from £12 to £19 depending upon the complexity of the game.



Additional cartridges NOW available include:

Stunt Cycle – 4 games – Cartridges and Hand Controls – **£14.90** + £1.14 VAT.
Tank Battle – Cartridge and Hand Controls – **£18.90** + £1.51 VAT.
Road Race – 2 games – Cartridge – Controls already with basic kit – **£12.90** + £1.03 VAT.

Fully assembled add £3.00.

Cartridges come complete with printed case and easy to follow assembly instructions.

REALISTIC SOUND EFFECTS

All parts fully guaranteed.

Electrical knowledge is not a necessity to assemble this project – just simple soldering.

Cheques and Postal Orders to be made payable to **TELEPLAY**; send your order **(No Stamp Needed)** to Teleplay, Freepost, Barnet, EN5 2BR or telephone your order quoting your Barclaycard or Access number. Queries and Technical Advice offered either by phone or by calling at our shop.

BARCLAYCARD VISA

SHOP OPEN – 10am to 7pm – Monday to Saturday

CLOSE TO NEW BARNET BR STATION – MOORGATE LINE

We welcome Access

Watch this page each month for new cartridges, as they become available.

All prices include Postage.

Compare our prices with similar products in the big stores, which cost well over £100.

teleplay

EUROPE'S LARGEST STOCKIST OF TV GAME COMPONENTS.

14 Station Road, New Barnet, Herts EN5 1QW Tel: 01-440 7033/01-441 2922

PRACTICAL
ELECTRONICS

VOLUME 14 No.15 NOVEMBER 1978

CONSTRUCTIONAL PROJECTS

MOON LANDING GAME *by A. Russell*
Sixty seconds to avoid a negative altitude situation 1138
P.E. V.D.U. SYSTEM—2 *by A. A. Berk, B.Sc., Ph.D.*
Construction and setting up 1146
PROXIMITY SWITCH *by A. K. Langford*
A variable sensitivity touch and proximity switch 1160
ANALOGUE COMPUTER—3 *by P. J. Kronis, B.Sc.*
Wiring, testing and programming 1165
WIDE RANGE C/R BRIDGE *by W. English*
1000µF/10MΩ 1180

GENERAL FEATURES

POWER FETs *by David Shortland*
The latest developments in field effect technology 1154
INGENUITY UNLIMITED
741 Supply—Soldering Iron Simmer Control—Auto-Tune Generator—Touch Tuner 1173

NEWS AND COMMENT

EDITORIAL 1137
EXCLUSIVE OFFER
Two irons at special prices 1143
SPACEWATCH *by Frank W. Hyde*
German Satellite, U.S. Satellite, TDRSS, Pioneer Venus 2, TRS, Intelsat Terminal, Spacelab 2 1144
NEWS BRIEFS
Starlight Vision 1153
Bubbling with Bits—Blinking Good—On the Levell 1170
Data Encryption Unit 1182
MARKET PLACE
New products
SEMICONDUCTOR UPDATE *by R. W. Coles*
A look at some recently released devices 1179
STATESIDE SCENE *by Dave Coutts*
New York News 1182
SPECIAL SUBSCRIPTION OFFER 1185
INDUSTRY NOTEBOOK *by Nexus*
What's happening inside industry 1186
PATENTS REVIEW
Thought provoking ideas on file at the British Patents Office 1187
READOUT
A selection of readers' letters 1188
POINTS ARISING 1188

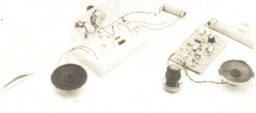
SPECIAL 8-PAGE SUPPLEMENT

CAR DEVICES Auto-Light—Vari-Wipe—Assisted Ignition System—Intruder Alarm—Battery State Indicator—Polarity Inverter between 1164 and 1165

Our December issue will be on sale Friday, 10 November 1978
(for details of contents see page 1145)

© IPC Magazines Limited 1978. Copyright in all drawings, photographs and articles published in PRACTICAL ELECTRONICS is fully protected, and reproduction or imitations in whole or part are expressly forbidden. All reasonable precautions are taken by PRACTICAL ELECTRONICS to ensure that the advice and data given to readers are reliable. We cannot, however, guarantee it, and we cannot accept legal responsibility for it. Prices quoted are those current as we go to press.

DeC-IT and BLOB-IT

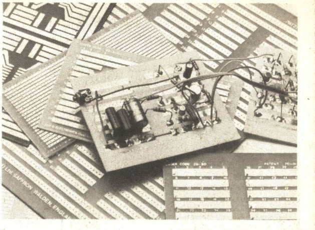


S - DeC No simpler way of learning circuit construction
S - DeC No quicker way of getting circuit working
S - DeC Simply plug components in NO SOLDERING
S - DeC All components can be RE-USED
S - DeC All holes identified by number
S - DeC All contact rails identified by raised line
S - Dec Complete with project book
S - DeC For quick circuit try-outs
S - DeC Test Components before soldering
S - DeC Large working area
S - DeC Test Parts of circuits
S - DeC Used in many teaching courses
S - DeC Guaranteed life time contacts
S - DeC LOW PRICE

£3.78
+ 55p
p & p

S - DeC + control panel + step by step instructions + 9 project booklet + Matching Blob-Board

BLOB-BOARDS



Blob-Board now available in many different layouts and sizes
Blob-Board can be used to build any type of project
Blob-Board has roller tinned tracks for super soldering
Blob-Board has letter numbers on it, no need for layout drawings
Blob-Board does not require any cutting or breaking or contact rails
Blob-Board components can be re-used and re-soldered making circuit project modifications and amendments fast easy and cheap.
Blob-Board is low in price.

All Blob-Board packs contain a project booklet, the "ic" range has a 20 project booklet and "D" range has a 9 project booklet.

CODE	SIZE mm	PRICE
ZB5D	92 x 61	£0.44
ZB1 IC	114 x 76	£0.66
ZB2 IC	115 x 78	£0.71
ZB4 IC	127 x 203	£1.90
ZB8 IC	254 x 203	£3.69
ZB8D	165 x 251	£2.88

All prices include VAT
Please add 35p p & p minimum order £3.00
Available from all good component stockists

ASTRA-PAK

92 GODSTONE ROAD
WHYTELEAFE SURREY CR3 0EB

All prices **include** V.A.T. Add 25p for P&P (Extra for overseas). **Discounts** over £10 less 5%, over £20 less 10%, over £50 less 15%, over £100 less 20%.
Send SAE for complete list of components.

7400 and 74LS Series TTL

	74N	74LSN
7400	0.12	021
7401	0.12	0.21
7402	0.12	0.21
7403	0.12	0.21
7404	0.13	0.21
7405	0.13	0.21
7406	0.28	
7407	0.28	
7408	0.14	0.21
74S08	0.40	
7409	0.14	0.21
7410	0.13	0.22
7411	0.18	0.21
7412	0.21	0.21
7413	0.25	0.46
7414	0.54	1.05
7415		0.21
7416	0.27	
7417	0.27	
7420	0.13	0.21
7421	0.28	0.21
7422	0.17	0.21
7423	0.25	
7425	0.20	
7426	0.25	0.28
7427	0.25	0.30
7428	0.34	0.34
7430	0.13	0.21
74S30	0.30	
7432	0.24	0.31
7437	0.24	0.26
7438	0.24	0.26
7440	0.13	0.22
7441	0.52	
7442	0.55	0.70
7443	0.90	
7444	0.90	
7445	0.70	
7446	0.70	
7447A	0.60	0.94
7448	0.60	0.94
7449		0.94
7450	0.13	
7451	0.13	0.21
7453	0.13	
7454	0.13	0.21
7455		0.26
7460	0.13	
7470	0.28	
7472	0.22	
7473	0.26	0.36
7474	0.26	0.38
73S74	0.50	
7475	0.30	0.42
7476	0.26	0.39
7478		0.39
7480	0.45	
7481	0.90	
7482	0.75	
7483	0.72	0.97
7484	0.90	
7485	0.88	0.97

	74N	74LSN
7486	0.26	0.38
74S86	1.50	
7489	2.00	
7490	0.35	0.95
7491	0.65	
7492	0.44	0.82
7493	0.40	0.95
7494	0.80	
7495	0.54	1.05
7496	0.60	1.30
7497	2.00	
74100	0.94	
74104	0.40	
74105	0.40	
74107	0.28	0.40
74109	0.45	0.40
74110	0.46	
74111	0.70	
74112		0.40
74113	0.30	0.40
74114		0.40
74116	1.60	
74118	0.82	
74119	1.25	
74120	0.82	
74121	0.25	
74122	0.40	
74123	0.50	0.59
74124		1.25
74125	0.40	0.46
74126	0.45	0.46
74128	0.62	
74132	0.68	0.82
74134	0.36	
74135	0.68	
74136	0.55	0.40
74137	0.94	
74138		0.62
74139		0.62
74141	0.58	
74142	2.00	
74143	2.00	
74144	2.00	
74145	0.64	1.20
74147	1.30	
74148	1.15	
74150	0.99	
74151	0.60	0.90
74153	0.60	0.56
74154	1.00	1.32
74155	0.63	0.98
74156	0.63	0.98
74157	0.63	0.60
74158	0.58	0.62
74159	1.70	
74160	0.80	1.30
74161	0.80	0.80
74162	0.80	1.30
74163	0.80	0.82
74164	0.89	1.20
74165	0.89	
74166	0.99	
74167	2.70	

	74N	74LSN
74168		2.10
74169		2.10
74170	1.68	1.94
74172	4.00	
74173	1.18	1.12
74174	0.89	1.12
74175	0.68	1.12
74S175	3.25	
74176	0.80	
74177	0.82	
74178	1.20	
74179	1.10	
74180	0.90	
74181	1.75	3.38
74182	0.75	
74S182	2.30	
74H183	0.99	
74184	1.20	
74185A	1.20	
74186	7.20	
74188	2.70	
74189		3.60
74190	1.05	0.96
74191	0.99	0.96
74192	0.99	1.50
74193	1.05	1.50
74194	0.90	2.00
74195	0.84	1.40
74196	0.90	1.15
74197	0.90	1.15
74198	1.48	
74199	1.48	
74221	1.50	1.05
74247		0.80
74248		0.95
74249		0.95
74251	1.00	0.95
74253		1.10
74257		1.12
74258		1.15
74260		0.28
74261		3.25
74266		0.43
74273	2.15	1.80
74279	1.25	0.55
74283	1.70	1.05
74284	6.85	
74289		3.92
74290		0.95
74293	1.35	1.00
74298	1.92	1.40
74352		1.00
74353		1.05
74365		0.52
74366		0.52
74367		0.46
74368		0.52
74386		0.58
74390	1.92	
74393	2.00	
73670		2.30

LINEARS

CA3045	–14	0.45
CA3046	–14	0.70
LM380N	–14	0.82
LM381N	–14	1.20
LM710N	–14	0.32
LM711N	–14	0.32
MC1310P	–14	1.50
NE555N	–8	0.30
NE556N	–14	0.65
NE2501B	–14	2.00
SN72702N		0.50
SN75110N		0.50
SN76003N		1.95
SN76013N		1.35
SN76023N		1.35
SN76033N		1.95
TAA550B		0.35
TAA661B		1.40
TBA120S		0.64
TBA641A		1.88
TBA800		0.75
TBA810S		1.04
TCA270SQ		2.00
TDA2020		3.20
ZN414		1.00

OP AMPS

CA3130	–T099	1.00
LM301A	–8	0.30
LM301A	–T099	0.46
LM348N	–14	1.00
LM709	–8	0.40
LM709	–14	0.42
LM709	–T099	0.50
LM741	–8	0.22
LM741	–14	0.20
LM741	–T099	0.45
LM747	–14	0.70
LM3900N		0.50
MC1458P	–8	0.42

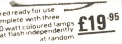
VOLTAGE REGULATORS

LM300	–T099	1.00
LM309K	–T03	1.30
uA723	–14	0.40
7805	T0220	0.85
7812	T0220	0.85
7815	T0220	0.85
7824	T0220	0.85
7905	T0220	1.10
7912	T0220	1.10
7915	T0220	1.10

DIL SOCKETS

8 pin	0.11
14 pin	0.12
16 pin	0.13
18 pin	0.23
20 pin	0.27
22 pin	0.29
24 pin	0.30
28 pin	0.44
40 pin	0.55

Random FLASHER UNIT



Wired ready for use
Complete with three 100 watt coloured lamps that flash independently at random
£19·95

TWIN BANK 6 LIGHT UNIT

(less lamps) LENGTH 14½ inches

BC Fitting **£11·35** EACH
ES Fitting **£11·35** EACH

Sound to Light MASTER UNIT

600 WATTS PER CHANNEL

£30·95
INCLUDING CHANNEL OUTPUT PLUGS AND MAINS INPUT SOCKET

TYPE A SPOT

(less lamp)

BC Fitting	ES Fitting
£2·30 EACH	£2·30 EACH

TYPE B 3 BANK UNIT

(Less Lamps)

BC Fitting **£7·99** EACH
ES Fitting **£7·99** EACH

100 WATT SPOT LAMPS
RED, YELLOW, GREEN, BLUE, CLEAR **£1·50 each**
B.C. or E.S. Fitting
Minimum 3 lamps £4·50

TWIN BANK 12 LIGHT UNIT

Length 31¾"

(less lamps)
BC Fitting **£18·50** EACH
ES Fitting **£18·50** EACH

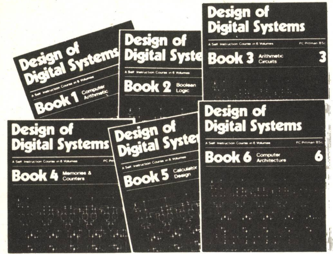
ALL PRICES INCLUDE V.A.T. and POST & PACKING
(These prices apply to the United Kingdom only)

Send 20p for illustrated leaflet & price list.

ALBEN ENGINEERING CO. LTD.,
DEPT. PE THE CRESCENT, WORSTHORNE,
BURNLEY. LANCS. Tel·Burnley 20940

Understanding Digital Electronics

New teach-yourself courses


Design of Digital Systems
Book 1 Computer Arithmetic
Book 2 Boolean Logic
Book 3 Arithmetic Circuits
Book 4 Memories & Counters
Book 5 Calculator Design
Book 6 Computer Architecture
A Self Instruction Course in 6 Volumes
PC Pittman BSc

Design of Digital Systems is written for the engineer seeking to learn more about digital electronics. Its six volumes – each A4 size are packed with information, diagrams and questions designed to lead you step-by-step through number systems and Boolean algebra to memories, counters and simple arithmetic circuits, and finally to a complete understanding of the design and operation of calculators and computers.

The contents of Design of Digital Systems include:

Book 1 Octal, hexadecimal and binary number systems; conversion between number systems; representation of negative numbers; complementary systems; binary multiplication and division.

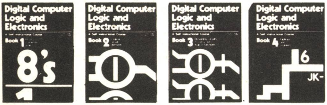
Book 2 OR and AND functions; logic gates; NOT, exclusive-OR, NAND. NOR and exclusive-NOR functions; multiple input gates; truth tables; De Morgans Laws; canonical forms; logic conventions; Karnaugh mapping; three-state and wired logic.

Book 3 Half adders and full adders; subtractors; serial and parallel adders; processors and artithmetic logic units (ALUs); multiplication and division systems.

Book 4 Flip flops; shift registers; asynchronous and sychronous counters; ring, Johnson and exclusive-OR feedback counters; random access memories (RAMs) and read only memories (ROMs).

Book 5 Structure of calculators; keyboard encoding; decoding display data; register systems; control unit; program ROM; address decoding; instruction sets; instruction decoding; control program structure.

Book 6 Central processing unit (CPU); memory organization; character representation; program storage; address modes; input/output systems; program interrupts; interrupt priorities; programming; assemblers; computers; executive programs; operating systems and time sharing.


Digital Computer Logic and Electronics
A Self Instructional Course
Book 1
8's
Book 2
Book 3
Book 4
6
JK-

Digital Computer Logic and Electronics is designed for the beginner. No mathematical knowledge other than simple arithmetic is assumed, though the student should have an aptitude for logical thought. It consists of four volumes – each A4 size – and serves as an introduction to the subject of digital electronics. Everyone can learn from it – designer, execxutive, scientist, student, engineer.

Contents include: Binary, octal and decimal number systems; conversion between number systems; AND, OR, NOR and NAND gates and inverters; Boolean algebra and truth tables; De Morgans Laws; design of logic circuits using NOR gates; R-S and J-K flip flops; binary counters, shift registers and half adders.

CAMBRIDGE LEARNING ENTERPRISES. Unit 22, Rivermill Site, FREEPOST, ST. IVES, HUNTINGDON, CAMBS. PE22 4BR, ENGLAND. TELEPHONE ST. IVES (0480) 67446. PROPRIETORS: DRAYRIDGE LTD. REG. OFFICE: RIVERMILL LODGE, ST. IVES. REGD. IN ENGLAND NO. 1328762

In the years ahead the products of digital electronics technology will play an important part in your life. Calculators and digital watches are already commonplace. Tomorrow a digital display could show your vehicle speed and fuel consumption; you could be calling people by entering their name into a telephone which would automatically look up their number and dial it for you.

These courses were written by experts in electronics and learning systems so that you could teach yourself the theory and application of digital logic. Learning by self-instruction has the advantages of being faster and more thorough than classroom learning. You work at your own pace and must respond by answering questions on each new piece of information before proceeding.

After completing these courses you will have broadened your career prospects and increased your fundamental understanding of the rapidly changing technological world around you.

The six volumes of Design of Digital Systems cost only:	**£8.10**	**+90p post & packing**
And the four volumes of Digital Computer Logic and Electronics cost only:	**£4.60**	**+90p post & packing**
But if you buy both courses, the total cost is only:	**£12**	**+£1 post & packing**

Price includes surface mail anywhere in the world: Airmail extra.

Flow Charts & Algorithms

HELP YOU PRESENT:
safety procedures, government legislation, office procedures, teaching materials and computer programs by means of YES and NO answers to questions.

THE ALGORITHM WRITER'S GUIDE explains how to: define the questions, put them in the best order and draw the flow chart, with numerous examples shown. All that students require is an aptitude for logical thought. Size: A5, 130 pages. This book is a MUST for those with things to say.

£2.95 + 45p post and packing by surface mail anywhere in the world. Airmail extra.

GUARANTEE
If you are not entirely satisfied your money will be refunded.

Cambridge Learning Enterprises, Unit 22, Rivermill Site,
FREEPOST, St. Ives, Huntingdon, Cambs. PE17 4BR, England.

Please send me the following books:
............sets Digital Computer Logic & Electronics @ £5.50, p & p included
............sets Design of Digital Systems @ £9.00, p & p included
............Combined sets @ £13.00, p & p included
............The Algorithm Writer's guide @ £3.40, p & p included

Name..

Address..

....

....

I enclose a *cheque/PO payable to Cambridge Learning Enterprises for £......................

Please charge my *Access/Barclaycard/Visa/Eurocard/Mastercharge/Interbank account number..

Signature...*delete as appropriate.

Telephone orders from credit card holders accepted on 0480-67446 (Ansafone). Overseas customers should send a bank draft in sterling drawn on a London Bank, or quote credit card number. PE22

BREAD BOARD 1978

The kits & bits show for the home electronics enthusiast

Seymour Hall Seymour Place London W1

21–25 November 1978

Seventy stands packed with the gear that the home electronics constructor needs. From kits for keen youngsters just starting – to components for the dedicated enthusiast intent on building his own computer, it can all be seen and bought on the spot in the Seymour Hall this November. Browse through the range of instrumentation, test gear, components and circuit boards. Kits for making everything from an electric grandfather clock to an electronic organ. Build your own microprocessor, construct your own television games and choose hi-fi audio modules for the ultimate in sound!

Watch the **Demonstrations** in adjoining halls – electronic projects brought to life by the experts – and a chance for you to try for yourself the latest ideas from manufacturers and journals.

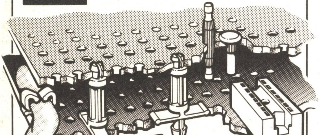
Competitions – Win a microprocessor kit – a frequency counter – a 'starter' kit for the kids – and many other daily prizes throughout the show.

Open 10 a.m. – 7 p.m. daily.
Entrance £1.00 adults, 70p students.

Organised by Trident Conferences and Exhibitions Limited, Abbey Mead House, 23a Plymouth Road, Tavistock, Devon. PL19 8AU.
Tel: 0822 4671 Telex: 45412 TRITAV.

---

vero



Our new 1978 catalogue lists circuit board accessories for all your projects – DIP sockets, pins standoffs, cable clips, hand tools. And we've got circuit boards, module systems, cases and boxes – everything you need to give your equipment the quality you demand. Send 25p to cover post and packing, and the catalogue's yours.

VERO ELECTRONICS LTD. RETAIL DEPT.
Industrial Estate, Chandlers Ford, Hants. SO5 3ZR
Telephone Chandlers Ford (04215) 2956

Clef Products

P. E. JOANNA
&
'STRING ENSEMBLE'

Send S.A.E. for details of Kits & P.C.B.s
Please indicate which instrument required.

16 Mayfield Road, Bramhall, Cheshire SK7 1JU

NEW! AMERICAN TYPE CRADLE

TELEPHONE AMPLIFIER

ONLY **£16·95** +VAT £1·36

Latest transistorised Telephone Amplifier with detached plug-in speaker. Placing the receiver on to the cradle activates a switch for immediate two-way conversation without holding the handset. Many people can listen at a time. Increase efficiency in office, shop, workshop. Perfect for "conference" calls: leaves the user's hands free to make notes, consult files. No long waiting, saves time with long-distance calls. On/off switch, volume. Conversation recording model at **£19·95** + VAT £1·60. P. & P. 89p. 10-day price refund on all items.

MAINS INTERCOM

NO BATTERIES NO WIRES ONLY £32·99 PER PAIR +VAT £4·13

The modern way of instant 2-way communications. Supplied with 3-core wire. Just plug into power socket. Ready for use. Crystal clear communications from room to room. Range ¼-mile on the same mains phase. On/off switch. Volume control. Useful as inter-office intercom, between office and warehouse, in surgery and in homes.

P. & P. 99p.

WEST LONDON DIRECT SUPPLIES (PE11)
169 KENSINGTON HIGH STREET, LONDON W8 6SN
Tel: 01-937 5548

WATFORD ELECTRONICS

35 CARDIFF ROAD, WATFORD, HERTS., ENGLAND
MAIL ORDER, CALLERS WELCOME. Tel. Watford 40588/9

ALL DEVICES BRAND NEW, FULL SPEC. AND FULLY GUARANTEED. ORDERS DESPATCHED BY RETURN OF POST. TERMS OF BUSINESS: CASH/CHEQUE/ P.O.s OR BANKERS DRAFT WITH ORDER. GOVERNMENT AND EDUCATIONAL INSTITUTIONS' OFFICIAL ORDERS ACCEPTED. TRADE AND EXPORT INQUIRY WELCOME. P&P ADD 30p* TO ALL ORDERS UNDER £10.00. OVERSEAS ORDERS POSTAGE AT COST. AIR/SURFACE.

MINIMUM ORDER £2.00 PLEASE.

VAT Export orders no VAT. Applicable to U.K. Customers only. Unless stated otherwise, all prices are exclusive of VAT. Please add 8% to devices marked ★. To the rest add 12½%.

We stock many more items. It pays to visit us. We are situated behind Watford Football Ground. Nearest Underground/BR Station: Watford High Street. Open Monday to Saturday 9.00 am – 6.00 pm. Ample Free Car Parking space available.

POLYESTER CAPACITORS: Axial lead type. (Values are in μF) **400V:** 0.001, 0.0015, 0.0022, 0.0033 **7p;** 0.0047, 0.0068, 0.01, 0.015, 0.018 **9p;** 0.022, 0.033, **10p;** 0.047, 0.068 **14p;** 0.10 **15p;** 0.15, 0.22 **22p;** 0.33, 0.47 **39p;** 0.68 **45p.** **160V:** 0.039, 0.15, 0.22 **11p;** 0.33, 0.47 **19p;** 0.68, 1.0 **29p;** 1.5 **29p;** 2.2 **32p;** 4.7 **36p.** **DUBILIER: 1000V:** 0.01, 0.015 **20p;** 0.022 **22p;** 0.047 **26p;** 0.1 **38p;** 0.47 **48p.**

POLYESTER RADIAL LEAD (Values are in μF) **250V:** 0-01, 0-015, 0-022, 0-027 **5p;** 0-033, 0-047, 0-068, 0-1 **7p;** 0-15 **12p;** 0-22, 0-33 **13p;** 0-47 **15p;** 0-68 **18p;** 1-0 **24p;** 1-5 **27p;** 2-2 **31p.**

FEED THROUGH CAPACITORS
100μF 350V **8p**

ELECTROLYTIC CAPACITORS: Axial lead type (Values are in μF) **500V:** 10 **40p;** 47 **68p;** **250V:** 100 **65p;** **63V:** 0.47, 1.0, 1.5, 2.2, 2.5, 3.3, 4.7, 6.8, 8, 10, 15, 22 **8p;** 47, 32, 50 **11p;** 63, 100 **27p;** **50V:** 1.0 **7p;** 50, 100, 220 **25p;** 470 **50p;** 1000, 2200 **68p;** **40V:** 22, 33 **7p;** 100 **11p;** 3300 **62p;** 4700 **64p;** **35V:** 10, 33 **7p;** 330, 470 **32p;** 1000 **49p;** **25V:** 10, 22, 47 **6p;** 80, 100, 160 **8p;** 220, 250 **13p;** 470, 640 **25p;** 1000 **27p;** 1500 **30p;** 2200 **41p;** 3300 **52p;** 4700 **54p;** **16V:** 10, 40, 47, 68 **7p;** 100, 125 **8p;** 330, 470 **16p;** 1000, 1500 **20p;** 2200 **34p;** **10V:** 4, 100 **6p;** 640 **10p;** 1000 **14p.**

TAG-END TYPE: 70V: 2000 **98p;** 4700 **121p;** **50V:** 3000 **75p;** **40V:** 4000 **70p;** 2500 **65p;** **25V:** 4700 **48p;** 2000 **37p;** **40V:** 2000 + 2000 **95p;** **325V:** 200 + 100+ 50 + 100 **190p.**

TANTALUM BEAD CAPACITORS **35V:** 0.1μF, 0.22, 0.33, 0.47, 0.68, 1.0, 2.2μF, 3.3, 4.7, 6.8 **25V:** 1.5, 10 **20V:** 1.5 **16V:** 10μF **13p** each 47, 100 **40p.** **10V:** 22μF, 33, 47 **6V:** 47, 68, 100, **3V:** 68, 100μF. **20p** each

MYLAR FILM CAPACITORS

100V: 0.001, 0.002, 0.005, 0.01μF	**6p**
0.015, 0.02, 0.04, 0.05, 0.056μF	**7p**
0.1μF, 0.15, 0.2 **9p** **50V:** 0.47μF	**11p**

CERAMIC CAPACITORS: 50V

0.5pF to 10nF	**3p** each
15nF, 22nF, 33nF, 47nF	**4p** each
0.1μF	**6p**

POLYSTYRENE CAPACITORS
10pF to 1nF **6p;** 1.5nF to 47nF **10p.**

SILVER MICA (Values in pF) 3-3, 4-7, 6-8, 10, 12, 18, 22, 33, 47, 50, 68, 75, 82, 85, 100, 120, 150, 220 **9p** each
250, 300, 330, 360, 390, 600, 820 **16p** each
1000, 1800, 2000, 2200 **20p** each

CERAMIC TRIMMER CAPACITORS
2-7pF, 4-15pF, 6-25pF, 8-30pF **20p**

MINIATURE TYPE TRIMMERS

2.5-6pF, 3-10pF, 10-40pF	**22p**
5-25pF, 5-45pF, 60pF, 88pF	**30p**

COMPRESSION TRIMMERS

3-40pF, 10-80pF, 25-190pF	**25p**
100-500pF 38; 1250pF	**68p**

POTENTIOMETERS (AB or EGEN)
Carbon Track, ¼W Log & ½W Linear values

500Ω, 1K & 2K (lin only). Single	**27p**
5KΩ-2MΩ single gang	**27p**
5KΩ-2MΩ single gang D/P switch	**60p**
5KΩ-2MΩ dual gang stereo	**70p**

SLIDER POTENTIOMETERS
0-25W log and linear values 60mm

5KΩ-500KΩ single gang	**70p**
10KΩ-500KΩ dual gang	**80p**
Self Stick Graduated Bezels	**22p**

PRESET POTENTIOMETERS
Vertical & Horizontal

0-1W 50Ω–5MΩ Miniature	**8p**
0-25W 100Ω—3-3MΩ Horiz	**10p**
0-25W 200Ω—4-7MΩ Vert	**10p**

RESISTORS – Erie make 5% Carbon Miniature High Stability, Low noise

RANGE	VAL	1-99	100 +
¼W 2-2Ω-4-7M	E24	**1.5p**	**1p**
½W 2-2Ω-4-7M	E12	**2p**	**1.5p**
1W 2-2Ω-10M	E12	**5p**	**4p**
2% Metal Film 10Ω-1MΩ		**6p**	**4p**
1% Metal Film 51Ω-1M		**10p**	**8p**

100 - price applies to Resistors of each type not mixed values.

PE DIGITAL THERMOMETER
All parts available.
Send SAE for list.

OPTO ELECTRONICS★

LEDs plus clip	
TIL209 Red	**13**
TIL211 Grn	**18**
TIL212 Yellow	**22**
·2" Red	**15**
·2" Yellow Green	**19**
Spare Clips	**2**
LS400	**255**
TIL307	**695**
ORP12	**63**
2N5777	**45**
7 Seg Displays	
TIL312 C An 3"	**105**
TIL313 C Cth 3"	**105**
TIL321 C An 5"	**115**
TIL322 C Cth 5"	**115**
DI704 C Cth ·3"	**99**
DL707 C.A. ·3"	**99**
FND357	**120**
MAN3640	**175**
LCD 3½ digit	**975**

SWITCHES★

TOGGLE 2A 250V	
SPST	**28p**
DPDT	**38p**
4 pole on/off	**54p**
SUB-MIN TOGGLE	
SP changeover	**59p**
SPST on/off	**54p**
DPDT 6 tags	**70p**
DPDT Centre off	**79p**
DPDT Biased	**115p**
SLIDE 250V:	
1A DPDT	**14p**
1A DP c/over	**15p**
½A DPDT	**13p**
4 pole c/over	**24p**
PUSH BUTTON	
Spring loaded	
SPST on/off	**60p**
SPDT c/over	**65p**
DPDT 6 Tag	**85p**

	JACK PLUGS		SOCKETS		
	Screened chrome	Plastic body	open metal	moulded with break contacts	in line couplers
2·5mm	**12p**	**8p**	**8p**		**11p**
3·5mm	**15p**	**10p**	**8p**		**12p**
MONO	**23p**	**15p**	**13p**	**20p**	**18p**
STEREO	**31p**	**18p**	**15p**	**24p**	**22p**

	PLUGS	SOCKETS	In Line
DIN			
2 PIN Loudspeaker	**11p**	**7p**	**18p**
3, 4, 5 Pin Audio	**13p**	**8p**	**20p**
CO-AXIAL (TV)	**14p**	**14p**	**14p**
PHONO		**5p single**	**15p**
assorted colours	**9p**	**8p double**	—
Metal Screened	**12p**	**10p 3-way**	—
BANANA 4mm	**11p**	**12p**	—
2mm	**10p**	**10p**	—
1mm	**7p**	**7p**	—
WANDER 3mm	**9p**	**9p**	

SWITCHES ★ Miniature Non-Locking

Push to Make **15p**	Push to Break **25p**
ROCKER (white) 10A 250V SP changeover centre off	**30p**
ROCKER: (black) on/off 10A 250V	**23p**
ROCKER: Illuminated (white) Lights when on: 3A 240V	**52p**
ROTARY: (ADJUSTABLE STOP) 1 pole/2-12 way 2p/2-6W 3p/2-4W 4p/2-3W	**41p**
ROTARY: Mains 250V AC, 4 Amp	**45p**

DIL SOCKETS ★ (Low Profile – Texas)
8 pin **10p;** 14 pin **12p;** 16 pin **13p;** 18 pin **20p;** 20 pin **27p;** 24 pin **30p;** 28 pin **42p;** 40 pin **55p.**

DIGITAL MULTIMETER

Announcing DM900 – The Digital Multimeter with a difference – It measures Capacitance too. *(as published in E.T.I. August 1978)*

Throw away your analogue meters, here's digital accuracy at only half the price of an equivalent commercial Multimeter.

The DM900 is a 3½ digit multimeter with an 0.5in L.C.D. display incorporating:

5 AC & DC Voltage ranges; 6 Resistance ranges.

5 AC & DC Current ranges; 4 Capacitance ranges.

The prototype accuracy is better than 1%.

This is a unique design using the latest MOS ICs and due to the minimal current drain, is powered by only one PP3 battery. There is also a battery check facility.

DM900 is an attractive hand-held lightweight device, built into a high impact case with carrying handle and has been ingeniously designed to simplify assembly.

Never before have all these features been offered to the electronics enthusiast in a single unit.

Price: **£54.50*** only (p&p insured add 75p)

Ready Built units available on order
Send SAE for leaflet.
(Demonstration on at our shop)

PE VDU SYSTEMS

parts now available
(send SAE for list)

Convert your TV into a VDU by using the new Thomson-CSF. TV-CRT controller chip SF.F 96364. 16 lines by 64 characters, text refreshment, cursor management on TV screen, line erasing, line end erasing. Compatible with any computing system.

SFF 96364E	**£11.50***
AY-5-1013 UART	**£4.50***
71301 ROM	**£8.20***
SFS80102 RAM 1K	**£2.05***
74LS163 RAM	**£0.95***
SN75450	**120p***
SN75451	**70p***
SN75452	**70p***
SN75454	**225p***
2102 LF	**160p***
2513	**595p***
74LS132	**95p***
81LS97	**109p***
1 MHz crystal	**323p***

TTL 74★

7400	13
7401	13
7402	14
7403	14
7404	14
7405	18
7406	38
7407	38
7408	17
7409	17
7410	15
7411	20
7412	17
7413	30
7414	51
7416	30
7417	30
7420	16
7421	29
7422	24
7423	27
7425	27
7426	36
7427	27
7428	35
7430	17
7432	25
7433	40
7437	30
7438	33
7440	17
7441	74
7442	68
7443	115
7444	112
7445	94
7446	94
7447	82
7448	56
7450	17
7451	17
7453	17
7454	17
7460	17
7470	28
7472	25
7473	32
7474	27
7475	38
7476	36
7480	48
7481	86
7482	69
7483	72
7484	95
7485	106
7486	31
7489	210
7490	33
7491	75
7492	38
7493	32
7494	78
7495	65
7496	57
7497	189
74100	119
74105	62
74107	29
74109	64
74110	54
74111	68
74112	88
74116	198
74118	83
74119	119
74120	115
74121	25
74122	46
74123	48
74125	38
74126	57
74128	74
74132	73
74136	73
74141	56
74142	269
74143	314
74144	314
74145	65
74147	175
74148	109
74150	99
74151	64
74153	64
74154	96
74155	53
74156	80
74157	67
74159	210
74160	82
74161	92
74162	92
74163	92
74164	105
74165	105
74166	161
74167	20
74170	230
74172	625
74173	170
74174	87
74175	87
74176	75
74177	78
74178	102
74180	85
74181	165
74182	160
74184	135
74185	135
74188	275
74190	115
74191	105
74192	105
74193	105
74194	105
74195	95
74196	99
74197	85
74198	150
75150	110
75491	75
75492	80

CMOS★

4000	15
4001	17
4002	17
4006	105
4007	18
4008	87
4009	50
4010	50
4011	18
4012	18
4013	42
4014	86
4015	89
4016	45
4017	89
4018	89
4019	48
4020	99
4021	91
4022	88
4023	20
4024	66
4025	19
4026	180
4027	45
4028	81
4029	99
4030	50
4031	205
4032	100
4033	145
4034	196
4035	111
4036	325
4037	100
4038	108
4039	320
4040	105
4041	80
4042	75
4043	94
4044	88
4045	145
4046	128
4047	87
4048	58
4049	48
4050	48
4051	72
4052	72
4053	72
4054	110
4055	128
4056	134
4057	2570
4059	480
4060	99
4061	2380
4062	999
4063	110
4066	58
4067	380
4068	22
4069BE	20
4070	32
4071	21
4072	21
4073	21
4075	23
4076	85
4077	40
4078	21
4081	20
4082	21
4085	74
4086	73
4089	150
4093	85
4094	190
4095	105
4096	105
4097	372
4098	110
4099	145
4160	109
4161	109
4162	109
4163	109
4174	110
4175	99
4194	108
4408	720
4409	720
4410	720
4411	995
4412F	1650
4412F	1380
4415F	795
4415V	795
4419	280
4422	545
4433	1180
4435	825
4440	1275
4450	295
4451	295
4490F	695
4490V	525
4501	17
4502	120
4503	69
4506	51
4507	55
4508	298
4510	99
4511	150
4512	98

LINEAR IC'S

702	75
709C 14 pin	35
710★	48
723★	45
733★	99
741C★ 8 pin	22
747C★	70
748C★	36
753	150
810	159
8038CC★	335
AY-1-0212	580
AY-1-1313	660
AY-1-1320	305
AY-1-5050	208
AY-1-5051	145
AY-1-6721/6	195
AY-3-8500★	385
AY-3-8710★	750
AY-5-1224A★	260
AY-5-1230★	450
AY-5-1315	560
AY-5-1317A	630
CA3011★	82
CA3020	170
CA3023	170
CA3028A★	80
CA3035	223
CA3043	190
CA3046	71
CA3048	200
CA3075	175
CA3080E★	70
CA3081	190
CA3089E	210
CA3090AQ	375
CA3123E	200
CA3130★	85
CA3140★	70
ICL7106E★	950
ICM7205★	1150
LD130★	452
LM301H	170
LM301A	30
LM304	240
LM308	110
LM318	195
LM324★	79
LM339★	80
LM348★	95
LM379★	375
LM380	95
LM381	145
LM381AN	241
LM382	125
LM1458★	50
LM3900★	60
LM3909N★	70
LM3911★	125
M252AA★	750
M253AA★	795
MC724★	175
MC1303	88
MC1304P	260
MC1310	149
MC1312P	195
MC1488★	99
MC1489★	99
MC1495★	395
MC1496	92
MC1710★	79
MC3401	69
MC3340P★	150
MC3360P	89
MFC4000B	85
MFC6040★	97
MK50398★	635
MK50362★	650
MM2102-2★	190
MM2112★	100
MM2112-2★	295
MM57160★	620
NE518A★	210
NE555★	29
NE556DB★	60
NE560★	325
NE561★	410
NE562★	410
NE565A★	185
NE566★	180
NE567★	157
NE571★	450
RAM2102-2★	210
RC4136D★	120
ROM2513★	700
SG3402	295
SN76003N	175
SN76013N	140
SN76023N	140
SN76033N	175
SN76115N	215
SN76477★	225
SN76227	115
TAA621AX1	228
TAA960	300
TBA120S	70
TBA540Q	220
TBA550Q	330
TBA641BX11	250
TBA651	180
TBA800	90
TBA810S	99
TBA820	70
TBA920Q	260
TDA1022★	595
TDA2020	320
TLO71CP★	60
TLO81CP★	52
TLO82CP★	96
TLO84CP★	130
UAA170	198
ZN414	90
ZN424	130
ZN425E★	375

TRANSISTORS

AC117★	35
AC125★	20
AC126★	20
AC127★	20
AC128★	20
AC141★	24
AC141K★	38
AC142★	24
AC142K★	38
AC176★	18
AC187★	20
AC188★	20
ACY17	35
ACY18★	40
ACY19★	40
ACY20★	40
ACY21	35
ACY22★	40
ACY28★	40
ACY39	78
ACY40★	48
ACY44	39
AD140★	69
AD149★	70
AD161★	42
AD162★	42
AF114★	25
AF115★	25
AF116★	25
AF117★	25
AF118★	55
AF121★	48
AF124★	55
AF125★	35
AF127★	35
AF139★	35
AF178★	70
AF180★	70
AF186★	50
AF239★	42
ASY26★	40
ASY27★	45
BC107★	9
BC107B★	10
BC108★	9
BC1088★	12
BC108C★	12
BC109★	9
BC109B★	12
BC109C★	12
BC113	17
BC114	19
BC115	19
BC116	19
BC117	15
BC118	19
BC119★	26
BC134	19
BC135	20
BC136	18
BC137	20
BC140★	28
BC142★	25
BC143★	25
BC147	7
BC148	7
BC149	8
BC153	14
BC154	14
BC157	10
BC158	11
BC159	11
BC160	27
BC167A	11
BC168C	12
BC169C	10
BC170	17
BC171	11
BC172	10
BC177★	17
BC178★	17
BC179★	17
BC182	9
BC182L	10
BC183	9
BC183L	10
BC184	9
BC184L	10
BC186	21
BC187★	28
BC212	9
BC212L	10
BC213	9
BC213L	11
BC214	9
BC214L	10
BC307B	14
BC308	13
BC328	13
BC338	12
BC441★	30
BC461★	30
BC477★	18
BC547	11
BC548	11
BC549	11
BC557	13
BC558	12
BCY30★	57
BCY34★	75
BCY39★	80
BCY40★	78
BCY43	75
BCY58★	22
BCY59★	22
BCY70★	15
BCY71★	17
BCY72★	17
BCY78★	20
BD115★	62
BD121★	95
BD123★	98
BD124★	115
BD131★	38
BD132★	38
BD133★	43
BD135★	36
BD136★	37
BD137★	36
BD138★	36
BD139★	36
BD140★	36
BD142★	59
BD145★	198
BD222★	60
BD695A★	75
BD696A★	75
BDY17★	195
BDY60★	110
BDY61★	165
BF115★	22
BF154★	25
BF156★	29
BF167	25
BF173★	25
BF177★	24
BF178★	25
BF179★	30
BF180★	20
BF181★	30
BF182★	30
BF183★	30
BF184★	30
BF194	10
BF195	10
BF196	10
BF197	10
BF198	18
BF200★	28
BF224A	18
BF244	24
BF256★	50
BF257★	26
BF258★	26
BF259★	30
BF394	22
BF594	40
BF595	38
BFR39	25
BFR40	25
BFR79	28
BFR80	28
BFX29★	26
BFX81★	130
BFX84★	24
BFX85★	24
BFX86★	28
BFX87★	23
BFX88★	24
BFY18★	50
BFY50★	20
BFY51★	20
BFY52★	20
BFY71★	20
BSX20★	18
BSY65★	30
BSY95★	25
BSY95A★	25
BU105	140
BU205★	190
BU208★	225
E5567	65
MD8001★	158
ME4102	10
ME6002	14
MJ400★	90
MJ491★	160
MJ2955★	95
MJE340★	45
MJE370★	55
MJE371★	60
MJE520★	45
MJE521★	65
MJE2955★	11
MJE3055★	70
MPF102	30
MPF103	36
MPF104	36
MPF105	36
MPF106	50
MPF107	50
MPSA05★	24
MPSA06★	24
MPSA12	40
MPSA55	24
MPSA56	24
MPSA70	34
MPSU02★	58
MPSU05	48
MPSU06	54
MPSU52★	65
MPSU55★	53
MPSU56★	56
MPU131★	39
OC25★	120
OC26★	150
OC28★	99
OC29★	160
OC35★	80
OC36★	99
OC41★	48
OC42★	32
OC43★	55
OC44★	31
OC45★	20
OC46★	28
OC70★	19
OC71★	25
OC72★	30
OC76★	36
OC77★	76
OC79★	76
OC81★	28
OC82★	45
OC83★	48
OC84★	44
OC122★	48
OC123★	48
OC139★	85
OC140★	85
OC141★	85
OC170★	40
OC171★	40
OC201★	75
OC202★	85
OC203★	85
OC204★	85
TIP29	43
TIP29A	44
TIP29C	60
TIP30	47
TIP30A	47
TIP30B	64
TIP30C	65
TIP31★	40
TIP31A★	40
TIP31B★	40
TIP31C★	66
TIP32★	45
TIP32A★	49
TIP32B★	70
TIP32C★	70
TIP33★	80
TIP33A★	80
TIP33B★	100
TIP33C★	105
TIP34★	85
TIP34A★	85
TIP34B★	110
TIP34C★	110
TIP35★	219
TIP35A★	225
TIP35C★	270
TIP36A★	265
TIP36C★	325
TIP41A★	63
TIP418★	73
TIP42A★	64
TIP42B★	82
TIP2955★	63
TIP3055★	60
TIS43	36
TIS44	45
TIS46	45
TIS50	47
TIS60	45
TIS62	45
TIS74	47
TIS90	18
TIS91	22
ZTX107	11
ZTX108	11
ZTX109	11
ZTX300	13
ZTX301	16
ZTX302	18
ZTX303	21
ZTX304	24
ZTX311	17
ZTX314	24
ZTX326	40
ZTX341	20
ZTX500	13
ZTX501	14
ZTX502	19
ZTX503	15
ZTX504	25
ZTX531	25
ZTX550	25
2N526★	58
2N696★	35
2N697★	21
2N698★	39
2N699★	39
2N706A★	19
2N707★	50
2N708★	19
2N914★	32
2N916★	27
2N918★	30
2N920★	51
2N930★	18
2N961★	61
2N1131★	22
2N1132★	22
2N1302★	35
2N1303★	50
2N1304★	50
2N1305★	28
2N1306★	35
2N1307★	50
2N1308★	46
2N1613★	23
2N1671★	190
2N1671B★	195
2N1893★	28
2N1986★	60
2N2160★	105
2N2217★	48
2N2218A★	31
2N2219A★	22
2N2220A★	26
2N2221★	23
2N2222★	20
2N2297	45
2N2303★	45
2N2368★	21
2N2369★	15
2N2476★	125
2N2483★	28
2N2484★	30
2N2646★	48
2N2784★	55
2N2846★	140
2N2894★	30
2N2904A★	22
2N2905A★	20
2N2906★	18
2N2907★	20
2N2907A★	22
2N2926G	10
2N29260	8
2N2926R	8
2N2926Y	8
2N3011★	24
2N3053★	20
2N3054★	49
2N3055★	55
2N3108	39
2N3121	40
2N3133	43
2N3135	33
2N3250	30
2N3252	36
2N3302	35
2N3442★	131
2N3563	20
2N3614★	169
2N3615★	135
2N3663	24
2N3702	10
2N3703	11
2N3704	10
2N3705	11
2N3706	10
2N3707	10
2N3708	10
2N3709	10
2N3710	16
2N3711	10
2N3715★	250
2N3772★	170
2N3773★	288
2N3819	22
2N3820	32
2N3823★	65
2N3824★	70
2N3866★	90
2N3903	18
2N3904	18
2N3905	18
2N3906	17
2N4037★	52
2N4058	17
2N4061	17
2N4064★	120
2N4236★	145
2N4289	20
2N4859	65
2N5135	42
2N5136	42
2N5138	20
2N5179★	60
2N5180★	60
2N5191★	65
2N5305★	24
2N5457	32
2N5458	32
2N5459	32
2N5485	32
2N5777★	45
2N6027	40
40311★	50
40313★	125
40316★	85
40317★	52
40324	85
40326★	52
40327★	62
40347★	80
40348★	101
40360★	43
40361★	45
40362★	48
40407★	50
40411★	289
40412★	63
40467	95
40576★	190
40594★	80
40595★	90
40603★	65
40636★	125
40673★	68

Diodes

IN4148	4
CRO33★	148
Zeners 400mw 2.7-33v	9

MAINS TRANSFORMERS (TM)

All have 230/240v 50Hz Primary

Voltage		Our Ref.	Price	Post
1v	2 amp	TM 1	£1.94	.40
2.4v	5 amp	TM 2	£1.62	.45
4v	7 amp	TM 32	£2.70	.60
6v	¾ amp	TM 3	.85	.40
6.5v	3 amp	TM 37	.85	.40
6.5v	200 mA	TM 21	£1.62	.40
6.5v-0-6.5v	100 mA	TM 21	£1.62	.40
6.5v-0-6.5v	750 mA	TM 7	£2.16	.45
6.3v-0-6.3v	100 mA	TM 33	£1.62	.40
6.3v	2 amp	TM 4	£1.89	.50
8.5v	1 amp	TM 12	£1.62	.40
8.5v + 8.5v sep. winding	½ amp	TM 12	£1.62	.40
9v	1 amp	TM 5	£1.62	.45
9v 'c' core	1 amp	TM 6	£1.89	.40
9v	3½ amp	TM 11	£2.70	.50
9v	5 amp	TM 38	£3.24	.60
10v	25 amp	TM 15	£4.86	£1.25
10v-0-10v	4 amp	TM 50	£3.78	£1.25
10v-0-10v	12½ amp	TM 15	£4.86	£1.25
12v	½ amp	TM 9	£1.05	.50
13v	100 mA	TM 21	£1.62	.40
13v	¾ amp	TM 7	£2.16	.50
12v	1 amp	TM 10	£1.89	.50
12v-0-12v	50 mA	TM 19	£1.62	.40
12v-0-12v	1 amp	TM 41	£3.24	.50
15v tapped 9v	2 amp	TM 11	£2.70	.50
17v	½ amp	TM 12	£1.62	.50
18v	¾ amp	TM 13	£1.90	.50
20v	½ amp	TM 14	£1.62	.50
20v (with 6v ½ amp)	2 amp	TM 50	£3.78	£1.25
20v	6 amp	TM 46	£4.32	£1.25
20v	12½ amp	TM 15	£4.86	£1.25
20v-0-20v	6 amp	TM 15	£4.86	£1.25
24v	1½ amp	TM 16	£2.12	.60
24v	2 amp	TM 17	£2.70	.60
24v + 2v 7 amp	2 amp	TM 39	£2.97	.70
24v	4 amp	TM 40	£3.78	.80
25v	1½ amp	TM 18	£2.43	.60
26v	2 amp	TM 39	£2.98	.60
30v	8 amp	TM 15	£4.86	£1.25
37v	37 amp	TM 34	£31.86	Enquire
40v	3 amp	TM 46	£4.32	£1.25
40v	5 amp	TM 48	£5.02	£1.25
40v tapped @ 30v, 20v & 10v	6 amp	TM 15	£4.86	£1.25
40v-0-40v	2½ amp	TM 48	£5.02	£1.25

FREE GIFT
To all customers this month we will send a free copy of our unique booklet
"TEST EQUIPMENT"

50v – 2 amp with 6.3v shrouded	—	TM 22	£4.86	£1.25
50v	8 amp	TM 29	£11.65	£1.75
60v tapped 40v & 20v	2 amp	TM 46	£4.32	£1.25
70v	4.5 amp	TM 24	£7.02	£2.50
75v – 3 amp with 6.3v shrouded	—	TM 23	£8.10	£2.00
75v	4½ amp	TM 24	£7.02	£2.50
80v tapped 70v & 75v	4 amp	TM 24	£7.02	£2.50
80v centre tapped	2½ amp	TM 48	£5.02	£1.25
100v	1 amp	TM 25	£7.02	£1.75
100v-0-100v	½ amp	TM 25	£7.02	£1.75
200v	½ amp	TM 25	£7.02	£1.75
250v-0-250v with 6.3v 2A	50 mA	TM 36	£3.78	£1.00
250v	100 mA	TM 36	£3.78	£1.00
500v	50 mA	TM 36	£3.78	£1.00
260v	60 mA	TM 26	£3.24	£1.00
1000v (and other secs)	60 mA	TM 43	£6.50	£2.00
4 Kv	5 mA	TM 49	£4.05	.70
5 Kv	5 mA	TM 30	£7.02	£1.00
8 Kv	5 mA	TM 45	£4.05	£1.00
8.5 Kv	10 mA	TM 31	£10.26	£2.00

Full range of
Mains to 120v Auto-transformers available

SOUTHERN TRANSFORMERS
103 TAMWORTH ROAD
CROYDON CR9 1SG

HI-PERFORMANCE ELECTRONIC
(CAPACITOR DISCHARGE)
IGNITION UNIT

. . . Good for your car and your pocket

Fit one to-day and SAVE, SAVE, SAVE!

Why pay more when you can enjoy the advantages of true capacitor discharge ignition (CDI) at virtually pre-inflation prices? The benefits to your car and your pocket are enormous – easy starting in the coldest of cold weather, an end to burnt contacts and arcing problems, better engine wear and petrol consumption and, of course, easy and secure fitting to your vehicle. ORDER NOW WHILE WE CAN HOLD TO THESE PRICES –
State if for pos. or neg. earth.

INC. V.A.T. AND POST FREE IN U.K.

READY BUILT ONLY
£14·95

D·I·Y KIT COMPLETE
£12·75

Why be without?

- **MADE IN OUR OWN U.K. FACTORY**
- **SWITCH FOR INSTANT RETURN TO ORDINARY IGNITION**
- **NEG OR POS EARTH MODELS**
- **HEAVY GAUGE ENCLOSED METAL CASE**
- **BUILT FOR YEARS OF DEPENDABLE SERVICE**
- **FULL 12 MONTHS GUARANTEE**

Pay by Access or Barclaycard if you wish

STIRLING SOUND
37 VANGUARD WAY, SHOEBURYNESS, ESSEX.
Tel: (03708) 5543
Shop – 222/224 West Rd., Westcliff-on-Sea.

To Stirling Sound, 37 Vanguard Way,
Shoeburyness, Essex.
Please send.......... CDI Unit ready built @ **£14.95**
.... CDI Kit @ **£12.75**

NAME..

ADDRESS...

....

PE.11

AT BREADBOARD'78 Stand : D3

Prices are each, net & exclude V.A

Experimentor Series

EXP300	(6 x 2.1 in., 5 x 94 terminals & 2 bus strips)	£5.7
EXP350	(3.5 x 2.1 in., 5 x 46 terminals x 2 bus strips)	£3.1
EXP600	(6 x 2.4 in., 5 x 94 terminals x 2 bus strips)	£6.3
EXP650	(3.6 x 2.4 in., 5 x 46 terminals x 2 bus strips)	£3.6
EXP4B	(6 x 4 in., 2 bus strips only)	£2.3

Quick Test Series

QT-59S	(6.5 x 6.2 in., 118 terminals)	£7.2
QT-47S	(5.3 x 5 in., 94 terminals)	£5.7
QT-35S	(4.1 x 3.8 in., 70 terminals)	£4.9
QT-18S	(2.4 x 2.1 in., 36 terminals)	£2.7
QT-12S	(1.8 x 1.5 in., 24 terminals)	£2.1
QT-8S	(1.4 x 1.1 in., 16 terminals)	£1.9
QT-7S	(1.3 x 1 in., 14 terminals)	£1.7
QT-59B	(6.5 x 6.2 in., 20 terminals)	£1.4
AT-47B	(5.3 x 5 in., 16 terminals)	£1.3
QT-35B	(4.1 x 3.8 in., 12 terminals)	£1.1

Protoboard Series

PB-6	(630 tie points, 4 binding posts, 4 x 14 DIL capacity)	£9.2
PB-100	(760 tie points, 2 binding posts, 10 x 14 DIL capacity)	£11.8
PB-101	(940 tie points, 1 binding post, 10 x 14 DIL capacity)	£17.2
PB-102	(1240 tie points, 1 binding post, 12 x 14 DIL capacity)	£22.9
PB-103	(2250 tie points, 4 binding posts, 24 x 14 DIL capacity)	£34.4
PB-104	(3060 tie points, 4 binding posts, 32 x 14 DIL capacity)	£45.9
PB-203	(2250 tie points, 4 binding posts, 24 x 14 DIL capacity; built-in regulated 5V d.c. power unit)	£55.1
PB-203A	(As PB-203 with 5V and 15V d.c. power supply)	£74.7

Design Mate Instruments

DM-1 £45.95 DM-2 £57.45 DM-3 £57.45
DM-4 £74.70

IC Test Clips

PC-14 (14-pin) £2.60 PC-16 (16-pin) £2.7
PC-24 (24-pin) £4.90 PC-40 (40-pin) £7.9

Logic Probes

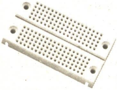
Hand-held logic probes, TTL/DTL/CMOS compatible, from £18 to £49.00

Logic Monitors for CMOS, HTL, DTL, TTL & RTL

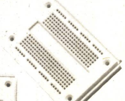
LM-1	Self-power clip-on logic monitor	£28.70
LM-2	As LM-1, with fully isolated power supply	£68.95

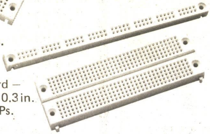
Postage, Packing and Insurance per shipment £1.25
Please add 8% VAT to overall total
Export orders: credit cards or internationa money orders, bank drafts and cheques drawn in £ sterling. Please add 10% (Europ or 12½% (all other countries) to total price

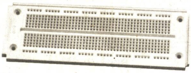
Now, from the breadboard specialists– even better boards!



Since the appearance of the first breadboards back in the '40's, we've really been going places. (The U.K., for one.) So we now have an exceptional range of prototyping products which are outstanding in their simplicity, versatility and reliability. Just see. (And for prices and specs., eyes left!)

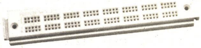






xperimentor Series.
ow-cost,
nterlocking,
olderless breadboard –
he world's first for 0.3 in.
nd 0.6 in. pitch DIPs.

2



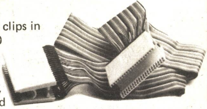
Quick Test Series.
Low-cost, snap-locking solderless circuit boards for fast design with discrete components.

3 **The Protoboard Series.**
Solderless breadboards with built-in 10% regulated 5Vd.c. 1A power supply; 2,250 solderless tie points; and capacity for DIPs of 14 to 40 pins.

4

Design Mate Test Instruments.
DM-1 power supply, 5V to 15Vd.c. at 600mA; DM-2 function generator for sine, square and triangle wave generation; DM-3 R/C bridge giving 10 ohm to 10 megohm, 10pF to 1.0µf; DM-4 pulse generator with 0.5 Hz to 5MHz frequency and 100ns to 1 sec pulse widths.

5 **IC Test Clips.**
Ultra-low cost IC clips in 14, 16, 24 and 40 pin versions.



And, much more too: logic monitors, probes, frequency counters and test equipment to ensure the best, fastest results from your design.

Take a look at our low, low prices and quality specs., and get aboard! (Or if its data you're after, pick up the phone or drop us a line.)

For the best, from the specialists in breadboards.

Continental Specialities Corporation (UK) Ltd., Unit 1, Shire Hill Industrial Estate, Dept. 5H, Saffron Walden, Essex CB11 3AQ.

CONTINENTAL SPECIALTIES CORPORATION
CSC

Continental Specialties Corporation (U.K.) Ltd., Unit 1, Shire Hill Industrial Estate, Dept. 5H
Saffron Walden, Essex. CBII 3AQ Telephone (0799) 21682 Telex 817477 Reg. in London: 1303780.
VAT No: 224 8074 71. *Trade Mark applied for © CSC (UK) Ltd. 1977 Dealer enquiries welcome.

Please supply ______________________________

______________________ Price ____________ Total ____________

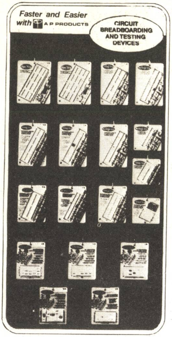
Name ______________________ Address ______________________

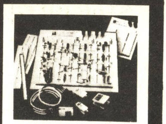
______________________ My cheque/postal order No ________ for £ ________ is enclosed

My Access/American Express/Barclaycard no. is ______________ All I want is data, please. ☐

We're on Stand BI at the Breadboard exhibition.

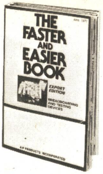
BONA FIDE UK TRADERS ONLY!





THIS IS THE PLACE
FASTER AND EASIER BEGINS.

AP PRODUCTS INCORPORATED



A Fast and Easy Profit Message from Lektrokit

For hobbyists and home project constructors, Lektrokit have put together the most comprehensive range of breadboarding and testing devices on earth. For you, Lektrokit have display racks, window stickers and catalogues to help you sell the entire range – faster and easier.

For you, too, Lektrokit will be advertising to hobbyists and home project constructors continuously – telling them about the Lektrokit products that you supply. If, of course, you have the stocks. And that's up to you.

Launch dates for Lektrokit's exciting new range are November 21-25 – at BREADBOARD 1978 – but you can get in on it NOW! Just use the coupon.

LEKTROKIT completes the circuit

To Lektrokit Ltd., Sutton Industrial Park, Earley,
Reading, Berks RG6 1AZ. Telephone 0734 669116.

I am a bona fide UK trader. Please send full information about **faster and easier** profit by Lektrokit.

Name ________________ Address ________________

________________ ________________ Tel. ________________

PE1

Codespeed

WHERE YOU CAN BE SURE OF A BARGAIN

Full Spec. Devices

CALCULATOR PACK M4 Contains a production line reject calculator. Either fix them (not much wrong with some we checked) or strip them for spares (whichever part is defective the rest must be good value for money – case/keyboard/display/chip/PCB). We include all the info. we can find on repairing calculators. What a bargain at **£2.50**

PACK M1 2 Calculator keyboards. Each has 17 keys and two switches. Only **£1.00**

PACK M2 1 x 2102, a 1024 bit Static R.A.M. The most popular R.A.M. in professional and amateur electronics. With full data. **£1.25**

PACK M3 Build your own calculator! MM5725 calculator chip and data book. **£1.00**

PACK E2 An 8 digit calculator style Liquid Crystal display. 0.33" high digits with right hand decimal points and overflow indicator. With data. **£2.95**

PACK E3 Same as Pack E2 but with 0.5" high digits. **£4.25**

PACK E4 A 1½ digit 0.3" high 7 segment gas discharge display. Requires 180V anode volts but can make an excellent replacement for LED's in some of your mains operated projects. Fantastic value. With info. **90p**

PACK E5 Same as Pack E4 but dual digit. **90p**

PACK E6 Contains a brand new 6 digit Texas Instruments type DIS436 LED display. Multiplexed with built in bubble magnifiers. **£1.00**

PACK E7 A Genuine Burroughs Panaplex II, 180 volt, 12 digit, 7 segment gas discharge display. 0.3" digits. We include the special socket FREE. With data **£1.50**

PACK T2 Back again by popular demand. A 0.2" 3½ digit Liquid Crystal wristwatch display with data. **£1.00**

PACK T4 An 0.8" giant red LED clock display. Common cathode, 3½ digit with AM/PM indicator. An excellent display for your digital clock projects at **£4.95**

PACK P1 An MM5330 Digital Voltmeter I.C. Now build your own digital multimeter or panel meter using this versatile chip. With data and circuit diagram **£3.95**

PACK DM1 5 x 1· pin dual in line chips, each containing 23 quality matrixed signal diodes. With data. **50p**

PACK C1 5 x 12 pin Hybrid circuits each containing 16 resistors/capacitors. Useful values. Ideal for semiconductor circuits and PCB miniaturisation. With data. 5 hybrid circuits for **50p**

*** **SPECIAL OFFER PACK DM1/C** *** Buy a pack DM1 *and* a pack C1 for the special price of only **85p** for the pair.

Untested Devices

PACK E1 (80% Guaranteed Good) 5 x MAN3, 7 segment 0.127" common cathode LED displays. Excellent value **£1.00**

PACK DL1 (Untested – so no guarantees) Fantastic value for money. A jumbo pack of 30 mixed I.C.'s. There could be anything in this pack, linear, digital – who knows. Guaranteed a sell out at only **£1.00**

PACK MU1 (Untested – so no guarantees) Another bargain. 2 x Upper half of a calculator case with built in keyboard. Most are ex-equipment, but believed to be O.K. A snip at only **60p** the pair.

Your satisfaction is guaranteed or return the complete pack for replacement or a refund

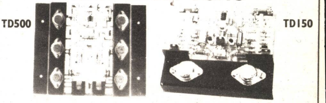
MAIL ORDER ONLY – NO CALLERS PLEASE
Postage and Packing please add 25p (Overseas Orders add 60p)

CODESPEED P.O. Box 23, 34 Seafield Road
Copnor, Portsmouth, Hants., PO3 5BJ

TUAC

TRANSISTOR UNIVERSAL AMPLIFICATION CO. LTD.
PHONE 01-672 3137/672 9080
MANUFACTURERS OF QUALITY AMPLIFICATION AND LIGHTING CONTROL SYSTEMS

NEW FROM TUAC



7" x 9" x 1¾" ULTRA QUALITY HIGH POWER 5" x 5" x 2"
New D.C. Coupled Design
AMPLIFIERS

Featuring—Electronic Short Open and Thermal Overload Protection.

Brief Spec.—Input Sensitivity 0·775 v. R.M.S. (O.D.B.) at 25K Ohms. Frequency Response 20 Hz – 20 KHz. T.H.D. at full power 0·1%. Hum and Noise—100 dB Relative full output.

T.D. 500 300W into 2 Ohms. 220W into 4 Ohms. 140W into 8 Ohms.	**£45·00**
Power supply P.S.300	**£30·00**
T.D.150 150W into 4 Ohms. 100W into 8 Ohms.	**£26·25**
Power supply P.S. 150	**£18·50**
T.D. 150 60 Version 60W into 8 Ohms. 40W into 15 Ohms.	**£17·75**
Power supply P.S.60	**£15·50**

Note—P.S. 300 will drive 2 T.D. 150 amplifiers

All output ratings are R.M.S. continuous sine wave output.

TO ORDER BY POST

Make cheques/P.O.s payable to TUAC LTD. (PE118) or quote Access/Barclay Card No. (We accept holders phone orders 01-672 9080.)

Post to—
TUAC LTD., (PE118), 119 CHARLMONT ROAD, LONDON SW17 9AB.
Send stamp for our free 28 page catalogue of LIGHTING & AMPLIFIER MODULES, etc.

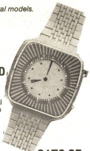
SEIKO – 20% OFF!

Analogue or digital from stock or to order.

CITIZEN – LARGE REDUCTIONS

on most quartz analogue and digital models.

TEXAS LCD ANALOGUE



TODAY'S MOST ADVANCED ELECTRONIC WATCH

Hours, minutes, seconds. Perpetual calendar. Chronograph timing from 1/10 sec to 12 hours. Dual time. Mineral glass.

Stainless steel case, bracelet **£179·95**

10 micron gold plated **£199·95**

SOLAR powered watches – so called
Misrepresentation? We WON'T sell them.
LED display watches – **We DON'T sell them.**
Send us a S.A.E. and we will tell you why not.

FAIRCHILD TIMEBAND

C 6110 Mains Digital Alarm Clock

STILL THE BEST!

Large LED display
24 hour alarm
9 minute snooze
Concealed controls
$3\frac{1}{4} \times 5\frac{1}{8} \times 3\frac{1}{8}$ins.
Black or white

£10·95

FROM CASIO – OF COURSE

BEDSIDE/TRAVEL ALARM CLOCK

Details and prices available Sept/Oct.

CQ-81 CALCULATING ALARM CLOCK

Plus 2 Alarm/Timers. 24 hour alarm and alarm/timers. 6 digit LCD clock. One year battery life. $1\frac{5}{8} \times 2\frac{3}{4} \times 5$ inches. (RRP £22·95) **£17·95**

FX-8000. 41 sc. funct. 1/100 sec stopwatch 2 × 5 Alarm/Timers (£35·95) **£29·95**

MINI CARD CALCULATORS $\frac{1}{8} \times 3\frac{1}{2} \times 2\frac{1}{8}$ins

LC-78 Full memory, %, √, K	**£16·95**
FX-48 Math Card Full Sc. with S.D.	**£19·95**
ST-24 Card Time 24 hour stopwatch (or clock) 2 Alarm/Timers. Calc as LC-78	**£19·95**

ALL Casio Scientifics. ***Lowest prices***

ST-1. ***Four way stopwatch*** **£24·95**

CARTRIDGE TV GAMES

OPTIM Coronet 600 Cartridges from **£9·95**

FAIRCHILD TIMEBAND Grandstand Cartridges from **£12·50**

ATARI Video Computer System
The very best available to date!
Cartridges from **£14·95**

● ***SPECIAL INTRODUCTORY OFFER***

FREE extra cartridge worth £14·95 with Atari

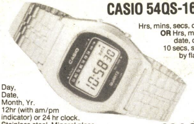
SAVE £££s WITH THE MONITEL

Telephone charge calculator and clock. UK model **£28·95.** International **£38·50.** State colour.

WATCH BATTERIES 65p each. D.I.Y. KIT 35p (with battery order).

THIS MONTH'S STAR BUY

CASIO 54QS-16B



Hrs, mins, secs, day. **OR** Hrs, mins, date, day, 10 secs, secs by flash.

Day,
Date,
Month, Yr.
12hr (with am/pm indicator) or 24 hr clock.
Stainless steel. Mineral glass.
Water resistant to 100 feet.

£34·95

LOW COST WATCHES

From National or similar high quality.

PH-G1 FOUR DIGIT *(Left)*

5 + 2 functions
Backlight

£9·95

PH-G2

As above + stopwatch

£14·95

PH - CHRONO *(above right)* 6 digits, 22 functions
Stopwatch measuring net, lap and 1st & 2nd place times to 1/100 second **£18·50**

PH - ALARM and ALARM/CHRONO

ALARM *(Left)*

Hours, mins, secs or date, day, am/pm. Day, date, month, year.

£28·95

CHRONO

Functions as above plus:

Chrono. Measuring net, lap and 1st & 2nd place times from 1/100 second to 1 hour, with rollover.
All stainless steel, mineral glass **£39·95**

LADIES' LCD WATCHES

5 functions. Backlight. Gold or silver finish.

Dress Watch. Round face. Milanese bracelet	**£14·95**
Cocktail Watch. 3 styles available	**£18·95**

CBM 4, 6 DIGIT and ALARM WATCHES

15 × 3. 4 digits, 5 functions. Stainless steel bracelet and finish. **£10·50**

16 × 3 *(Left)*
6 digits
6 functions Backlight
£12·95

ALARM 18 × 3
(Right)
6 digits 6 functions
+ backlight & alarm setting
5 minute snooze
£22·95

CASIO LADIES' LCD WATCHES

7 + 2 functions
Backlight

27CL-15B
Round, left.
(£35·95)
£29·95

27CL-17B
Stopwatch
(£49·95)
£39·95

CASIO QUALITY

All CASIO watches have a calendar display, night illumination, mineral glass and stainless steel cases, water resistant to 100 ft (except sports watches – 66 ft).

SPORTS WATCHES

F-100
Left: 9·45 mm
(£29·95)
£24·95

52QS-14B
Right 8 mm
(£44·95)
£34·95

Up to 25 functions. Net lap and first and second place times to 1/100th sec. F-100. Resin case, strap. 52QS-14B. S/S encased version and bracelet.

4 DIGIT WATCHES (except World Time).

Hours, minutes, ten seconds, seconds by flash, am/pm Day, date, month. Stopwatch. Dual time (except 31QR-20B).

31QR-20B
Left. 4 digit.
(£31·95)
£26·95

51QR-19B
6 digit
(£35·95)
£29·95

6 DIGIT WATCHES (except Sports and Alarm)

Hours, minutes, seconds, day, **OR** Hours, minutes, date, day, ten seconds, seconds by flash. Day, date, month, year. Selectable 12 hour (with am/pm) or 24 hour clock.

54QS-16B
Left. 6 digit.
(£44·95)
£34·95

54QS-15B
6 digit
(£49·95)
£39·95

CHRONOGRAPH. 6 digits as above, with stopwatch measuring net, lap and 1st & 2nd place times from 1/100 sec to 6 hrs. Dual time facility.

45CS-22B
Chronograph
Left. 6 digit.
(£64·95)
£49·95

29CS-11B
World Time
(£74·95)
£59·95

WORLD TIME WATCH. The time in ten capitals plus one optional time. Instant summertime correction. Hrs, mins, 10 secs, secs by flash. Perpetual calendar, day, date, month. Running digital seconds display.

ALARM WATCHES

25CR-16B
Round
(£64·95)
£49·95

25CS-16B
Square
(£74·95)
£59·95

Hours, mins, seconds (or hrs, mins, date) day, am/pm. Day, date, month, year. 24 hr alarm, on/off indicator.

ULTRA SLIM DRESS WATCHES

(NOT 24 hours)

53CS-18B
Left. 4 digit.
(£69·95)
£54·95

49CS-25B
6 digit
(£79·95)
£64·95

Not illustrated: **53CS-19B,** 4 digit, barrel shaped, **£54·95. 49CS-24B,** 6 digit (£74·95) **£59·95. 53CGS-17L,** gold plated, on strap (£84·95) **£69·95.**

Send 25p for our illustrated catalogue. Accurist, Casio, Citizen, Seiko, etc.
Prices include VAT P.&P. Send cheque, P.O. or phone your credit card No. to:

TEMPUS

Dept.P.E., Talk Of The Town, 19/21 Fitzroy Street
Cambridge CB1 1EH, Tel 0223 312866

SAXON ENTERTAINMENTS

THE PIONEERS OF MODULAR DISCO/P.A. EQUIPMENT NOW OFFER PACKAGE DEALS AT INCOMPARABLE PRICES

CENTAUR STEREO DISCOS

C/W LIGHT SHOW & DISPLAY, TWIN SPEAKERS & LEADS

Standard 100W

£249 or Deposit **£86.12**
12 Months @ **£19.90** + carr. £15.

Super 200W

£299 or Deposit **£102.12**
12 Months @ **£23.70** + carr. £15.

GXL 200W (with twin 200 watt cabinets)

£389 or Deposit **£131.32**
12 Months @ **£30.50** + carr. £15.

COMPLETE STEREO ROADSHOWS – BUILT IN SOUND TO LIGHT/SEQUENCER & DISPLAY

TWO YEAR GUARANTEE

illustration shows GXL Centaur System

These systems feature full mixing for two decks tape & mic with monitoring facilities – override and are supplied complete with sound to light + sequencer, display, speaker leads etc.

JUST PLUG IN AND GO!

BSR Decks – 17,000 Line Loudspeakers – Rugged Aluminium Trimmed Cabinets – Cue Light And Phones Output – Slave Output – Deck Lights/Motor Starts (GXL)

MINI DISCO 100 WATT MONO SYSTEM

£179.50 Deposit **£64**
12 Months @ **£14.00**
+ carr. £15

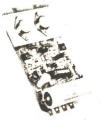
Similar in appearance to the Centaur and complete with loudspeakers and leads.

Headphones to suit any system	£7.50
EM507 Electret Mic	£15.00
ECM 81 Electret Mic	£19.95
Boom Stand	£15.50
Carriage on all disco and PA systems (Included in H.P. Prices)	£10.00

30% Deposits Terms On All Orders Over £150 – 12 or 24 Months – Low Interest

D.I.Y. MODULES FOR ALL DISCO/P.A. AMPLIFIERS

SA308 30W 8 ohms 45V	**£9.95***	SUPPLY FOR TWO MODULES	**£10.90***
SA604 60W 4 ohms 50V	**£13.25**	SUPPLY FOR TWO MODULES	**£13.50**
SA608 60W 8 ohms 65V	**£14.25**	SUPPLY FOR TWO MODULES	
SA1204 120W 4 ohms 75V	**£15.95**	SUPPLY FOR ONE MODULE	
SA1208 120W 8 ohms 95V	**£21.00**	SUPPLY FOR TWO MODULES	**£22.50**
SA2404 240W 4 ohms 95V	**£29.50**	SUPPLY FOR ONE MODULE	



0·2% Distortion, 30Hz-20, KHz ± 2dB, Fully Short/Open Circuit proof input sensitivity 240 mV to suit most mixers – D.C. & Output Fuses fitted.

TOP QUALITY COMPONENTS THROUGHOUT

DISCO MIXERS – COMPLETE OR MODULAR

MONO OR STEREO WITH AUTOFADE

Available complete and ready to plug in or as an easy to connect module with all controls except monitor switch already fitted – full instructions supplied.

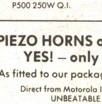
FEATURES INCLUDE:
Twin Deck – Mic & Tape Inputs – Wide range bass & treble controls – Full headphone monitoring – Crossfade – Professional standard performance.

MODULES	
Mono module	£22
Stereo module	£33
Panel	£3
Kit of knobs/sockets etc	£5
COMPLETE MIXERS (with	
Mono 18V	£39
Stereo 18V	£57
Mono mains	£45
Stereo mains	£63

COMPLETE LIGHTING CONTROL AT YOUR FINGERTIPS!

Lighting Control Unit Mk II 4kW Sequencer + Sound Light + Dimmers + Automatic Level Integrated Logic Circuitry		£44.50
	Module	£32.50
	Panel	£2.95
Three Channel Sound to Light 3kW 1-240W input – master Plus channel controls		£26.75
	Module	£19.75
	Panel	£2.95

STROBE UNITS



Pro-Strobe 4-6 Joules **£37.**
Super Strobe 2-3 Joules **£22.**
(Pro-Strobe has external trigg
facility).

SPARES & ACCESSORIES – LOUDSPEAKERS & CABINETS

Rope Lights – Red or Multicolour	**£39.50** per 30ft.	Melos Echo Chamber	£59.00
Rope Light Controller for up to 120 ft	**£30.00**	Headphones	£7.50*
Fuzz Lights–Red/Blue/Yellow/Green	**£22.80**	Sirens: English Police, USA Police, Destroyer, Alien Voice Simulator	£7.50
Magnetic Cartridge Equalisers	£3.50*	Bulgin 8 way lighting plug/socket	£1.90

100 Watt Chassis Loudspeakers 12″ **£23.50** 18″ **£47.50** (Add £1.50 carr.)
Empty Loudspeaker Cabinets: Small 12″ **£15.50**, Large 2 x 12″ **£28** Large 12″ **£21.50** 1 x 18″ **£29.50** Small 2 x 12″ **£22.50**

Projector lamps: A1167 **£2.90.** M6 **£5.65.**
100W Spot lamps Red/Blue/Yellow/Green **£1.50** ea **£13.50** for 10
MD Spot Banks: 3-way 300W **£19.50,** 4-way 400W **£22.50.**
Bubble machines (optikinetics) **£41.50**

Strobe tubes 80W **£8.50**
ICI Vynide 50″ wide **£3.50** Metre
Kickproof Grille 24″ wide **£3.25** Metre
Kick Resistant Grill 50″ wide **£3.25** Metre.
FULL RANGE OF RE-AN PRODUCTS IN STOCK
SEND FOR OUR BROCHURE NOW!!

PROJECTORS – PLUTO – NEW LOW PRICES!!! CHOICE OF WHEEL/CASSETTE

P150 150W Tungsten	**£37.50**	Liquid wheels	**£7.5**
P500 100W Q.I.	**£74.95**	Cassettes	**£8.0**
P500 250W Q.I.	**£84.95**	Picture wheels from (Wide choice available)	**£4.7**

PIEZO HORNS only £7.50 YES! – only £7.50

(As fitted to our package PA system)

Direct from Motorola Inc., USA at an UNBEATABLE PRICE

No crossover required 4kHz – 30kHz rated 75W/8 ohms 150W/4 ohms use two per 100W amplifier – Full instructions supplied.

AND

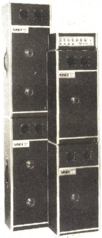
PACKAGE P.A. SYSTEMS (2 Year Guarantee)

Complete with PIEZO horn columns fitted with 100 watt units (100 watt system illustrated)

100 Watt £159.90 + carr. £15

Deposit £56.46
12 Months @ **£13.00**

Includes 4 Channel 100 Watt Amplifier with Treble, Bass and Master Controls plus Leads and Twin Piezo Horn Columns (shown on right).



200 Watt £249.00 + carr. £15

Deposit £86.12
12 Months @ **£19.90**

zsix Mixed Inputs plus Three Sets of Bass and Treble Controls **plus** Slave Output and Master Control.

ACCESSORIES

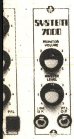
Melos Echo Unit £59.00

A high quality Cassette Tape Echo Unit giving long tape life, infinitely variable echo depth and speed control. Suitable for all mics. and instruments.

High quality Boom Stand **£15.50.** Floor Stand **£9.90.** ECM81 Condenser Mic. – Removable Lead – Good Anti-Feedback **£19.95.*** EM507 Condenser Mic. – Good Value **£15.00.** Phasers **£19.80.**

D.I.Y. MODULES FOR P.A. SYSTEMS Mono or Stereo

Make your own mixer – Mono/Stereo – up to 20 channels with these, easy to wire modules – Available as PCB's or assembled on panels.

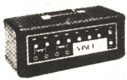


Input Stages Up to 20	Mono PCB	£5.95	Mono C/W panel etc.	£8.95
	Stereo PCB	£9.50	Stereo C/W panel etc.	£12.50
Mixer/Monitor (One only per system)	Mono PCB	£5.95	Mono C/W panel etc.	£8.95
	Stereo PCB	£9.50	Stereo C/W panel etc.	£12.50
Power supply for up to 20 channels		£9.50	Blank panel	£1.00

Send for free brochure for complete specification

Saxon AP100 Amplifier £45
Four mixing inputs – 100W into 4 ohms
Wide range bass & treble controls
+ master – Twin outputs

Saxon 150 Amplifier £59
Four mixing inputs – 100W into 8 ohms
150W into 4 ohms – wide range bass
& treble controls + master



l prices subject to 8% VAT except where asterisked (12½%)
op' premises open Tues to Sat 9 am - 5 pm Lunch 12.30 - 1.30 pm
ail order dept open Mon to Fri 10 am - 4 pm Ring 01-684 6385

TO ORDER

Post Send your requirements with cheque crossed P.O. or 60p COD charge to address below or just send your Access or Barclay Card Number NOT THE CARD.

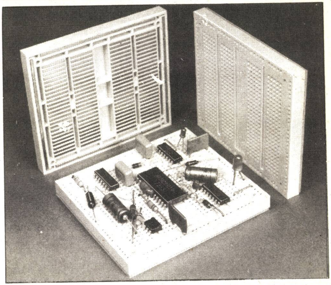
Phone You may order COD, Access or Barclay Card.

st & Packing 50p on all orders except where stated.

SAXON ENTERTAINMENTS
327 Whitehorse Road, Croydon, Surrey.
All Enquiries Large SAE Please Brochures on request.

ANNOUNCING

THE NEW EUROBREADBOARD



Logically laid out to accept both 0.3" and 0.6" pitch DIL packages as well as Capacitors, Resistors, LED's, Transistors and components with leads up to .85mm dia.

500 individual connections in the central breadboarding area, spaced to accept all sizes of DIL package without running out of connection points.

4 Integral Power Bus Strips around all edges for minimum interconnection lengths.

Double-sided, nickel silver contacts for long life (10K insertions) and low contact resistance (< 10m.ohms)

Easily removable, non-slip rubber backing allows damaged contacts to be rapidly replaced.

What other breadboarding system has as many individual contacts, offers all these features and only costs £5.80 inclusive of VAT and P.P. – NONE.

At £5.80 each The EuroBreadBoard is unique value for money.
At £11 for 2 The EuroBreadBoard is an indispensable design aid.

Snip out and Post
David George Sales, r/o 74 Crayford High St., Crayford, Kent, DA1 4EF

David George Sales
r/o 74 Crayford High Street,
Crayford, Kent, DA1 4EF.

Please send me 1 EuroBreadBoard @ £5.80 ☐ Please
or 2 EuroBreadBoards @ £11.00 ☐ Tick

(All prices include VAT and P.P., but add 15% for overseas orders).

Name . . . .

Company. . . . .

Address. . . . .

. . . .

. . . .

Tel. No. PE/11/78

Please make cheque/P.O.'s payable to David George Sales

BOOKS AND COMPONENTS

BOOKS BY BABANI

Purchase books to the value of £5·00 from the list below and choose any 60p pak from this page *FREE*

BP2	**Handbook of Radio, TV & Industrial & Transmitting Tube & Valve Equivalents**	**60p†**
BP6	**Engineers and Machinists Reference Tables**	**40p†**
BP7	**Radio & Electronic Colour Codes and Data**	**15p†**
BP10	**Modern Crystal and Transistor Set Circuits for beginners**	**35p†**
BP15	**Constructors Manual of Electronic Circuits for the Home**	**50p†**
BP22	**79 Electronic Novelty Circuits**	**75p†**
BP23	**First book of Practical Electronic Projects**	**75p†**
BP24	**52 Projects Using IC741(or equivalents)**	**75p†**
BP26	**Radio Antenna Handbook for Long Distance Reception and Transmission**	**85p†**
BP27	**Giant Chart of Radio Electronic Semiconductor and Logic Symbols**	**60p†**
BP29	**Major Solid State Audio Hi-Fi Construction Projects**	**85p†**
BP32	**How to Build Your Own Metal & Treasure Locators**	**85p†**
BP34	**Practical Repair & Renovation of Colour TVs**	**95p†**
BP35	**Handbook of IC Audio Preamplifier & Power Amplifier Construction**	**95p†**
BP36	**50 Circuits Using Germanium, Silicon & Zener Diodes**	**75p†**
BP37	**50 Projects Using Relays SCR's and TRIACS**	**£1·10†**
BP39	**50 (FET) Field Effect Transistor Projects**	**£1·25†**
BP43	**How to make Walkie-Talkies**	**£1·25†**
BP44	**I.C.555 Timer Projects**	**£1·45†**
BP47	**Mobile Discoteque Handbook**	**£1·35†**
BP129	**Universal Gram-motor Speed Indicator**	**10p†**
BP160	**Coil Design and Construction Manual**	**75p†**
BP196	**AF-RF Reactance Frequency Chart for Constructors**	**15p†**
BP202	**Handbook of integrated Circuits (ICs) Equivalents and Substitutes**	**75p†**
BP205	**First Book of Hi-Fi Loudspeaker Enclosures**	**75p†**
BP213	**Electronic Circuits for Model Railways**	**85p†**
BP214	**Audio Enthusiasts Handbook**	**85p†**
BP216	**Electronic Gadgets and Games**	**85p†**
BP217	**Solid State Power Supply Handbook**	**85p†**
BP219	**Solid State Novelty Projects**	**85p†**
BP220	**Build Your Own Solid State Hi-Fi and Audio Accessories**	**85p†**
BP222	**Solid State Short Wave Receivers for Beginners**	**95p†**
BP223	**50 Projects Using IC CA3130**	**95p†**
BP224	**50 CMOS IC Projects**	**95p†**
BP225	**A Practical Introduction to Digital IC's**	**95p†**
BP226	**How to Build Advanced Short Wave Receivers**	**£1·20†**
RCC	**Resistor Colour Code Disc Calculator**	**10p†**

BOOKS BY NEWNES

No. 229 Beginners Guide to Electronics	Price **£2·25†**
No. 230 Beginners Guide to Television	Price **£2·25†**
No. 231 Beginners Guide to Transistors	Price **£2·25†**
No. 233 Beginners Guide to Radio	Price **£2·75†**
No. 234 Beginners Guide to Colour Television	Price **£2·25†**
No. 235 Electronic Diagrams	Price **£1·80†**
No. 236 Electronic Components	Price **£1·08†**
No. 237 Printed Circuit Assembly	Price **£1·08†**
No. 238 Transistor Pocket Book	Price **£3·90†**
No. 225 110 Thyristor Projects Using SCRs & Triacs	Price **£2·50†**
No. 227 110 COS/MOS Digital IC Projects For the Home Constructor	Price **£2·25†**
No. 226 110 Operational Amplifier Projects for the Home Constructor	Price **£2·50†**
No. 242 Electronics Pocket Book	Price **£3.90†**
No. 239 30 Photoelectric Circuits & Systems	Price **£1·80†**

NUTS AND BOLTS

BA BOLTS packs of BA threaded cadmium plated screws slotted cheese head.

Supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
1in OBA	839	**£1·20**	½in 4BA	846	**£0·32**
½in OBA	840	**£0·75**	¼in 4BA	847	**£0·25**
1in 2BA	842	**£0·65**	1in 6BA	848	**£0·40**
½in 2BA	843	**£0·45**	½in 6BA	849	**£0·21**
¼in 2BA	844	**£0·52**	¼in 6BA	850	**£0·25**
1in 4BA	845	**£0·44**			

BA NUTS – packs of cadmium plated full nuts in multiples of 50.

Type	No.	Price	Type	No.	Price
OBA	855	**£0·72**	4BA	857	**£0·30**
2BA	856	**£0·48**	6BA	858	**£0·24**

BA WASHERS – flat cadmium plated plain stamped washers supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
OBA	859	**£0·14**	4BA	861	**£0·12**
2BA	860	**£0·12**	6BA	862	**£0·12**

SOLDER TAGS – hot tinned supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
OBA	851	**£0·40**	4BA	853	**£0·22**
2BA	852	**£0·28**	6BA	854	**£0·22**

SWITCHES

Description	No.	Price
DPDT miniature slide	1973	**£0·11***
DPDT standard slide	1974	**£0·14***
Toggle switch SPST 1½ amp 250V a.c.	1975	**£0·33***
Toggle switch DPDT 1 amp 250V a.c.	1976	**£0·42***
Rotary on-off mains switch	1977	**£0·50***
Push switch – Push to make	1978	**£0·13***
Push switch – Push to break	1979	**£0·18***

ROCKER SWITCH

A range of rocker switches SPST – moulded in high insulation. Material available in a choice of colours ideal for small apparatus.

Colour	No.	Price
RED	1980	**£0·26***
BLACK	1981	**£0·26***
WHITE	1982	**£0·26***
BLUE	1983	**£0·26***
YELLOW	1984	**£0·26***
LUMINOUS	1985	**£0·26***

Description	No.	Price
Miniature SPST toggle, 2 amp 250V a.c.	1958	**£0·50***
Miniature SPDT toggle, 2 amp 250V a.c.	1959	**£0·55***
Miniature DPDT toggle, 2 amp 250V a.c.	1960	**£0·70***
Miniature DPDT toggle, centre off, 2 amp 250V a.c.	1961	**£0·85***
Push button SPST, 2 amp 250V a.c.	1962	**£0·78***
Push button SPDT, 2 amp 250V a.c.	1963	**£0·83***
Push button DPDT, 2 amp 250V a.c.	1964	**£0·98***

MIDGET WAFER SWITCHES

Single-bank wafer type – suitable for switching at 250V a.c. 100mA or 150V d.c. in non-reactiver loads make-before-break contacts. These switches have a spindle 0·25in dia. and 30° indexing.

Description	Order No.	Price
1 pole 12 way	1965	**£0·48***
2 pole 6 way	1966	**£0·48***
3 pole 4 way	1967	**£0·48***
4 pole 3 way	1968	**£0·48***

MICRO SWITCHES	**Order No.**	**Price**
Plastic button gives simple on-off action Rating 10 amp 250V a.c.	1969	**£0·20**
Button gives 1 pole change over action Rating 10 amp 250V a.c.	1970	**£0·25**

FUSE HOLDERS AND FUSES

Description	Order No.	Price
20mm x 5mm chassis mounting	506	**£0·07***
1¼in x ¼in chassis mounting	507	**£0·12***
1¼in car inline type	508	**£0·15***
Panel mounting 20mm	509	**£0·20**
Panel mounting 1¼in	510	**£0·30**

QUICK BLOW 20mm

Type	No.	Type	No.	Type	No.
150mA	611	1A	615	3A	619
250mA	612	1·5A	616	4A	620
500mA	613	2A	617	5A	621
800mA	614	2·5A	618		

All **5p** each excepting 616 which is **7p.**

ANTI-SURGE 20mm

Type	No.	Type	No.	Type	No.
100mA	622	1A	625	2·5A	628
250mA	623	2A	626	3·15A	629
500mA	624	1·6A	627	5A	630

All 7p each

QUICK BLOW 1¼in

Type	No.	Type	No.	Type	No.
250mA	631	500mA	632	800mA	634

All 7p each

Type	No.	Type	No.	Type	No.
1A	635	2·5A	638	4A	641
1·6A	636	3A	639	5A	642
2A	637				

All 6p each

CASES AND BOXES

INSTRUMENT CASES. In two sections vinyl covered top and sides, aluminium bottom, front and back.

No.	Length	Width	Height	Price
155	8in	5½in	2in	**£1·52***
156	11in	6in	3in	**£2·12***
157	6in	4¾in	1¾in	**£1·30***
158	9in	5¼in	2½in	**£1·76***

ALUMINIUM BOXES. Made from bright ali., folded construction each box complete with half inch deep lid and screws.

No.	Length	Width	Height	Price
159	5¼in	2¼in	1½in	**62p***
160	4in	4in	1½in	**62p***
161	4in	2¼in	1½in	**62p***
162	5¼in	4in	1½in	**74p***
163	4in	2½in	2in	**64p***
164	3in	2in	1in	**44p***
165	7in	5in	2½in	**£1·04***
166	8in	6in	3in	**£1·32***
167	6in	4in	2in	**86p***

METAL FOIL CAPACITOR PAK

Containing 50 metal foil Capacitor—like Mullard C280 series. Mixed values ranging from [illegible]—2·2uf. Complete with identification sheet O/N 16204 **£1·20***

TRANSFORMERS

MINIATURE MAINS Primary 240V

No.	Secondary	Price
2021	6V-0-6V 100mA	**90p***
2022	9V-0-9V 100mA	**90p***
2023	12V-0-12V 100mA	**95p***

MINIATURE MAINS Primary 240V
with two independent secondary windings

No.	Type	Price
2024	MT280-0-6V, 0-6V RMS	**£1·50***
2025	MT150-0-12V, 0-12V RMS	**£1·50***

1 AMP MAINS Primary 240V

No.	Secondary	Price	
2026	6V-0-6V 1 amp	**£2·50***	P. & P. 45p
2027	9V-0-9V 1 amp	**£2·00***	P. & P. 45p
2028	12V-0-12V 1 amp	**£2·60***	P. & P. 55p
2029	15V-0-15V 1 amp	**£2·75***	P. & P. 66p
2030	30V-0-30V 1 amp	**£3·45***	P. & P. 86p

STANDARD MAINS Primary 240V

Multi-tapped secondary mains transformers available in ½ amp, 1 amp and 2 amp current rating. Secondary taps are 0-19-25-33-40-50V.

Voltages available by use of taps:
4, 7, 8, 10, 14, 15, 17, 19, 25, 31, 33, 40, 25-0-25V.

No.	Rating	Price	
2031	½ amp	**£5·50***	P. & P. 86p
2032	1 amp	**£6·60***	P. & P. 86p
2033	2 amp	**£8.40***	P. & P. £1·10

AUDIO LEADS

107	FM Indoor Ribbon Aerial	**£0·60***
113	3.5mm Jack plug to 3.5mm jack plug. Length 1.5m	**£0·75***
114	5 pin DIN plug to 3.5mm. Jack connected to pins 3&5. Length 1.5m	**£0·85***
115	5 pin DIN plug to 3.5mm. Jack connected to pins 1&4. Length 1.5m	**£0·85***
116	Car aerial extension. Screened insulated lead. Fitted plug & skt.	**£1·10***
117	AC mains connecting lead for cassette recorders & radios. 2 metres	**£0·68***
118	5 pin DIN phono plug to stereo headphone jack socket	**£1·05***
119	2+2 pin DIN plugs to stereo jack socket with attenuation network for stereo headphones. Length 0.2m	**£0·90***
120	Car stereo connector. Variable geometry plug to fit most car cassette, 8 track cartridge & combination units. Supplied with inline fused power lead and instructions.	**£0·60***
123	6.6m Coiled Guitar Lead Mono Jack Plug to Mono Jack Plug BLACK	**£1·50***
124	3 pin DIN plug to 3 pin DIN plug. Length 1.5m	**£0·75***
125	5 pin DIN plug to 5 pin DIN plug. Length 1.5m	**£0·75***
126	5 pin DIN plug to Tinned open end. Length 1.5m	**£0·75***
127	5 pin Din plug to 4 Phono Plugs. All colour coded. Length 1.5m	**£1·30***
128	5 pin DIN plug to 5 pin DIN socket. Length 1.5m	**£0·80***
129	5 pin DIN plug to 5 pin DIN plug mirror image. Length 1.5m	**£1·05***
130	2 pin DIN plug to 2 pin DIN inline socket. Length 5m	**£0·68***
131	5 pin DIN plug to 3 pin DIN plug. 1&4 and 3&5. Length 1.5m	**£0·83***
132	2 pin DIN plug to 2 pin DIN socket. Length 10m	**£0·98***
133	5 pin DIN plug to 2 phono plugs. Connected pins 3&5. Length 1.5m	**£0·75***
134	5 pin DIN plug to 2 phono sockets. Connected pins 3&5. Length 23cm	**£0·68***
135	5 pin DIN socket to 2 phono plugs. Connected pins 3&5. Length 23cm	**£0·68***
136	Coiled stereo headphone extension lead. Black. Length 6m	**£1·75***
178	AC mains lead for calculators etc.	**£0·68***

ELECTROLYTIC PAKS

A range of paks each containing 18 first quality, mixed value miniature electrolytics.

6201—values from ·47mFD—10mFD	**60p***
16202—values from 10mFD—100mFD	**60p***
16203—values from 100mFD—680mFD	**60p***

VISIT US AT BREADBOARD
SEYMOUR HALL, LONDON W1.
NOV 21st-25th
10 am to 7 pm

STANDS E2, E3, F2, F3, E10, E11

ORDERING Do not forget to state order number and your name and address.

V.A.T. Add 12½% to prices marked*, 8% to those unmarked. Items marked are zero rated.

P&P. 35p unless otherwise shown.

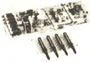
BI-PAK

DEPT. PE11, P.O. Box 6, Ware, Herts
COMPONENTS SHOP: 18 BALDOCK
STREET, WARE, HERTS.

High quality audio modules for Stereo and mono

S450

STEREO FM TUNER Fitted with phase lock-loop



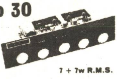
£22·30
+ 40p p&p
+ 12½% VAT

FREQUENCY RANGE	88–108 Mhz
SENSITIVITY	3·0 µV
BANDWIDTH	250 kHz
SPURIOUS REJECTION	50 dB
SELECTIVITY ± 400 kHz	55 dB
AUDIO OUTPUT (22 [illegible] kHz deviation)	100 mV
STEREO SEPARATION	30 dB
SUPPLY REQUIREMENTS	20 to 30V (90mA max)
AERIAL IMPEDANCE	75 ohms
DIMENSIONS	240mm × 110mm × 32mm

The 450 Tuner provides instant programme selection at the touch of a button ensuring accurate tuning of 4 pre-selected stations, any of which may be altered as often as you choose, simply by changing the settings of the pre-set controls. Features include FET input stage. Vari-Cap diode tuning. Switched AFC LED Stereo Indicator.

Stereo 30

COMPLETE AUDIO CHASSIS



£18·95
+ 40 p&p
+ 12½% VAT

7 + 7w R.M.S.

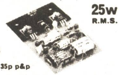
OUTPUT POWER	7 Watts RMS
LOAD IMPEDANCE	8 ohms
TOTAL HARMONIC DISTORTION	Less than ·5% (Typically ·3%)
FREQUENCY RESPONSE	50 Hz to 20 kHz ± 3dBs
TONE CONTROL RANGE	± 12 dBs at 100Hz and 10kHz
SENSITIVITY	190 mV for full output
INPUT IMPEDANCE	1 M ohms
TRANSFORMER REQUIREMENTS	22 V.A.C. rated at 1A
DIMENSIONS (Less controls and panel)	200mm × 130mm × 33mm

The Stereo 30 comprises a complete stereo pre-amplifier, power amplifiers and power supply. This, with only the addition of a transformer or overwind will produce a high quality audio unit suitable for use with a wide range of inputs i.e. high quality ceramic pick-up, stereo tuner, stereo tape deck etc. Simple to install, capable of producing really first class results, this unit is supplied with full instructions, black front panel, knobs, main switch, fuse and fuse holder and universal mounting brackets.

AL60

25w R.M.S.

AUDIO AMPLIFIER MODULE 25 Watts RMS



£4·55 **+ 35p p&p**
+ 12½% VAT

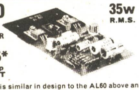
OUTPUT POWER	25 Watts RMS
SUPPLY	30–50 V
LOAD IMPEDANCE	8–16 ohms
TOTAL HARMONIC DISTORTION	Less than ·1% (Typically ·06%)
FREQUENCY RESPONSE	20 Hz to 30 kHz × 2 dBs
SENSITIVITY	280 mV for full output
MAX. HEAT SINK TEMPERATURE	90°C
DIMENSIONS	103mm × 64mm × 15mm

This high quality audio amplifier module is for use in audio equipment and stereo amplifiers and provides output powers up to 25 RMS with distortion levels below 0·1%.

AL80

35w R.M.S.

AUDIO AMPLIFIER MODULE



£7·15*
+ 35p p&p
+ 8% VAT

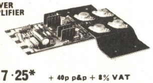
OUTPUT POWER	35 Watts RMS
SUPPLY	40–60 V
LOAD IMPEDANCE	8–16 ohms
TOTAL HARMONIC DISTORTION	Less than ·1% (Typically ·06%)
FREQUENCY RESPONSE	20 Hz to 30 kHz × 2 dBs
SENSITIVITY	280 mV for full output
MAX. HEAT SINK TEMPERATURE	90°C
DIMENSIONS	103mm × 64mm × 15mm

The AL80 is similar in design to the AL60 above and is of the same high quality but provides output powers up to 35W with distortion levels below 0·1%.

AL250

125w R.M.S.

POWER AMPLIFIER



£17·25* **+ 40p p&p + 8% VAT**

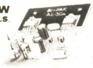
OUTPUT POWER	125 Watts RMS continuous
OPERATING VOLTAGE	50–80 V
LOADS	4–16 ohms
FREQUENCY RESPONSE	25 Hz 20 kHz measured at 100 Watts
SENSITIVITY FOR 100 WATTS O/P AT 1 kHz	450 mV
INPUT IMPEDANCE	33 K ohms
TOTAL HARMONIC DISTORTION	
50 WATTS into 4 ohms	0·1%
50 WATTS into 8 ohms	0·06%

This unit, designated AL250, is a power amplifier providing an output of up to 125W RMS, into a 4 ohm load.

AL30A

10w R.M.S.

AUDIO AMPLIFIER MODULES



£3·75 **+ 35p p&p**
+ 12½% VAT

MAXIMUM SUPPLY VOLTAGE	30 V
POWER OUTPUT for 2% THD	10 Watts RMS
TOTAL HARMONIC DISTORTION	Less than ·25%
LOAD IMPEDANCE	8–16 ohms
INPUT IMPEDANCE	100 K ohms
FREQUENCY RESPONSE	50 Hz–25 kHz ± 3 dBs
SENSITIVITY	75 mV for full output
DIMENSIONS	74mm × 63mm × 28mm

These low cost 5 and 10 watt modules offer the utmost in reliability and performance, whilst being compact in size.

SPM80

STABILISED POWER SUPPLY

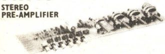
£4·25 **+ 35p p&p**
+ 12½% VAT

INPUT A.C. VOLTAGE	33–40V
OUTPUT D.C. VOLTAGE	33 V nominal
OUTPUT CURRENT	10 mA–1·5 amps
OVERLOAD CURRENT	1·7 amps approx.
DIMENSIONS	105mm × 63mm × 30mm

Designed to power two AL60s at 15 Watts per channel simultaneously. Circuit Techniques include full short circuit protection.

PA100

STEREO PRE-AMPLIFIER



£15·80
+ 40p p&p
+12½% VAT

FREQUENCY RESPONSE	20 Hz to 20 kHz × 1 dB
TOTAL HARMONIC DISTORTION	Less than ·1% (Typically ·07%)
SENSITIVITY INPUTS	1. TAPE 100 mV/100 K ohms 2. RADIO TUNER 100 mV/100 K ohms 3. MAGNETIC P.U. 3·5 mV/50 K ohms For an output 250 mV
EQUALISATION	Within ± 1 dB from 20 Hz to 20 kHz
BASS CONTROL RANGE	± 15 dBs at 75 Hz
TREBLE CONTROL RANGE	+ 10–20 dBs at 15 kHz
SIGNAL/NOISE RATIO	Better than 65 dBs (All inputs)
INPUT OVERLOAD	Better than 26 dBs (All inputs)
SUPPLY	20 to 40 V
DIMENSIONS	300 × 90 × 33mm (less controls)

A top quality stereo pre-amplifier and tone control unit, the PA100 provides a comprehensive solution to the front end requirements of stereo amplifiers or audio units. The six push button selector switch gives a choice of inputs together with two filters for high and low frequencies.

MPA30

MAGNETIC CARTRIDGE PRE-AMPLIFIER

£2·95
+35p p&p
+ 12½% VAT

Enjoy the quality of a magnetic cartridge with your existing ceramic equipment using the MPA 30 which is a high quality pre-amplifier enabling magnetic cartridges to be used where facilities exist for the use of ceramic cartridges only.

SENSITIVITY	3·5 mV for 100 mV output
EQUALISATION	Within ± 1 dB from 20 Hz to 20 kHz
INPUT IMPEDANCE	50 K ohms
SUPPLY	18 to 30 V—re earth
DIMENSIONS	110 × 50 × 25mm (inc DIN socket)

PA12

STEREO PRE-AMPLIFIER

£7·10
+ 30p p&p
+ 12½% VAT

The PA12 Stereo Pre-Amplifier chassis is designed and recommended for use with the AL 20/30 Audio Amplifier Modules, the PS12 power supply and the T538 Transformer. Features include on/off volume, Balance, Bass and Treble controls. Complete with tape output.

FREQUENCY RESPONSE	20 Hz–20 kHz (—3dB)
BASS CONTROL	± 12 dB at 60 Hz
TREBLE CONTROL	± 14 dB at 10 kHz
INPUT IMPEDANCE	1 Meg. ohm
INPUT SENSITIVITY	300 mV
CROSSTALK	—60 dB
SIGNAL/NOISE RATIO	—65 dB
OVERLOAD FACTOR	± 20 dB
TAPE OUTPUT IMPEDANCE	25 K ohms
DIMENSIONS	152mm × 84mm × 25mm

PS12 POWER SUPPLY

Designed for use with the AL30A S.450 and MPA30 in conjunction with transformer T538.

INPUT VOLTAGE	17–20v AC
OUTPUT VOLTAGE	27–30v DC
OUTPUT CURRENT	800mA
SIZE	60mm × 43mm × 26mm

£1·30
+ 35p p&p
+ 12½% VAT

GE 100 NINE CHANNEL MONO-GRAPHIC EQUALIZER

The GE100 has nine 1 octave adjustments using integrated circuit active filters. Boost and Cut limits are ± 12dB. Max. Voltage handling 2 V RMS, T.H.D., 0·05%, input impedence 100K. Output impedence less than 10 K. Frequency response 20 Hz –20 KHz (3dB). The nine gain controls are centred at 50, 100, 200, 400, 800, 1,600, 3,200, 6,400 and 12,800 Hz. The suggested gain controls are 10 K LIN sliders (not supplied with the module) See Paks S31 and 16192.

£22·00
+ 35p p&p
+ 12½% VAT

SG30 POWER SUPPLY BOARD for GE100 15-0-15 VOLT **£5·50 + 12½% VAT + 35p p&p**

SIREN ALARM MODULE

American Police screamer powered from any 12 volt supply into 4 or 8 ohm speaker. Ideal for car burglar alarm, freezer breakdown and other security purposes. Order No. S15. No. BP124.
Only £3·50 + 8% VAT + 35p p&p

MA60 HI-FI AMPLIFIER KIT

Build you own top quality amplifier, save yourself pounds. The MA60 kit comprises the following BI-kits modules, 2 × AL60 amps, 1 × PA100 pre-amp, 1 × SPM80 stab. power supply, 1 × BMT80 transf. giving 17 watts RMS per channel STEREO. All modules covered by the BI-PAK satisfaction or money back guarantee. Details of the above modules are in this ad.
Price £32·00 + 12½% VAT + 62p p&p.

TC60 KIT

A beautifully designed genuine TEAK WOOD veneered cabinet to put the professional touches to your home built amplifier. Full set of parts incl. Front & Back Panels, Knobs, Chassis, Fuses, Sockets, Noen, etc. Ideal for the MA60. Size: 425mm × 290mm × 95mm.
Price £19·95 + 12½% VAT + 86p p&p

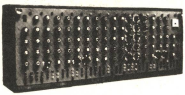
TRANSFORMERS

T538 For use with S.450 AL30A MPA30
Order No. **2036** Price: **£3·20** + 55p p&p + 12½% VAT
T2050 For use with Stereo 30
Order No. **2050** Price: **£3·25** + 55p p&p + 12½% VAT
BMT80 For use with AL60 SPM80
Order No. **2034** Price: **£5·40** + 86p p&p + 12½% VAT
BMT250 For use with AL250
Order No. **2035** Price: **£6·35** + **£1·10** p&p + 12½% VAT

BI-PAK

DEPT.PE11, P.O.Box6, Ware, Herts

KITS FOR SYNTHESISERS, SOUND EFFECT



COMPONENTS SETS include all necessary resistors, capacitors, semiconductors, potentiometers and transformers. Hardware such as cases, sockets, knobs, keyboards, etc. are not included but most of these may be bought separately. Fuller details of kits, PCBs and parts are shown in our lists.

CIRCUIT AND LAYOUT DIAGRAMS are supplied free with all PCBs unless "as published".

PHOTOCOPIES of P.E. texts for most of the kits are available—prices in our lists.

PHONOSONICS

MAIL ORDER SUPPLIERS OF QUALITY PRINTED CIRCUIT BOARDS, KITS AND COMPONENTS TO A WORLD-WIDE MARKET.

P.E. MINISONIC Mk. 2 SYNTHESISER

A portable mains-operated Miniature Sound Synthesiser, with keyboard circuits. Although having slightly fewer facilities than the large P.E. Synthesiser the functions offered by this design give it great scope and versatility. Consists of 2 log VCOs, VCF, 2 envelope shapers, 2 voltage controlled amps, keyboard hold and control circuits, HF oscillator and detector, ring modulator, noise generator, mixer, power supply.

Set of basic component kits	from £61·00
Set of printed circuit boards	£8·99

P.E. SYNTHESISER (P.E. Feb. 73 to Feb. 74)

The well acclaimed and highly versatile large-scale mains-operated Sound Synthesiser complete with keyboard circuits. Other circuits in our lists may be used with the Synthesiser to good advantage.

The Main Synthesiser: PSU, 2 linear VCOs, 2 ramp generators, 2 input amps, sample hold, noise generator, reverb amp, ring modulator, peak level circuit, envelope shaper, voltage controlled amp.

Set of basic component kits	£79·09
Set of printed circuit boards	£13·20

The Synthesiser Keyboard Circuits (can be used without the Main Synthesiser to make an independent musical instrument): 2 logarithmic VCOs, divider, 2 hold circuits, 2 modulation amps, mixer, 2 envelope shapers and PSU.

Set of basic component kits	£47·34
Set of printed circuit boards	£7·66

GUITAR EFFECTS PEDAL (P.E. July 75)

Modulates the attack, decay and filter characteristics of an audio signal not only from a guitar but from any audio source, producing 8 different switchable effects that can be further modified by manual controls. Possibly the most interesting of all the low-priced sound effects units in our range. Circuit does not duplicate effects from the Guitar Overdrive Unit.

Component set with special foot operated switches	£7·69
Alternative component set with panel switches	£5·05
Printed circuit board	£1·43

SOUND BENDER (P.E. May 74)

A multi-purpose sound controller, the functions of which include envelope shaper, tremolo, voice-operated fader, automatic fader and frequency-doubler.

Component set for above functions (excl. SWs)	£8·17
Printed circuit board	£1·81

Optional extra—additional Audio Modulator, the use of which, in conjunction with the above component set, can produce "jungle-drum" rhythms.

Component set (incl. PCB)	£2·88

PHASING UNIT (P.E. Sept. 73)

A simple but effective manually controlled unit for introducing the "phasing" sound into live or recorded music.

Component set (incl. PCB)	£3·20

PHASING CONTROL UNIT (P.E. Oct. 74)

For use with the above Phasing Unit to automatically control the rate of phasing.

Component set (incl. PCB)	£4·74

SOPHISTICATED PHASING AND VIBRATO UNIT

A slightly modified version of the circuit published in "Elektor", December 1976, and includes manual and automatic control over the rate of phasing and vibrato.

Component set	£17·38
Printed circuit board	£2·33

WAH-WAH UNIT (P.E. Apr. 76)

The Wah-Wah effect produced by this unit can be controlled manually or by the integral automatic controller.

Component set (incl. PCB)	£3·63

AUTOWAH UNIT (P.E. Mar. 77)

Automatically produces Wah-pedal and Swell-pedal sounds each time a new note is played.

Component set, PCB, special foot switches	£7·67
Component set and PCB, with panel switches	£4·83

P.E. JOANNA PLUS ORGAN VOICING

The basic five octave electronic piano (P.E. May/Sept 75 and Sound Design) has switchable alternative voicings for Honky-Tonk, ordinary piano, and Harpsichord or a mixture of any of these three, together with facilities including fast and slow tremolo, loud and soft pedal switching, and sustain pedal switching. The modification retains all the circuitry associated with the piano but in addition provides an organ-voice envelope facility with 5 switchable pitches, variable attack and sustain, phasing and vibrato.

Set of components (excl switches) for PSU, Frequency generator, Pitch and Note Divider, Envelope Shapers, Voicings, and Control circuitries. (Order as KIT 71-5)	£99·25
Set of PCBs (Order as PCB SET 71-6)	£29·18

SYNTHESISER TUNING INDICATOR (P.E. July 77)

A simple 4-octave frequency comparator for use with synthesisers and other instruments where the full versatility of the P.E. Tuning Fork is not required.

Component and PCB (but excl sw.)	£7·45

GUITAR FREQUENCY DOUBLER (P.E. Aug. 77)

A modified and extended version of the circuit published.

Component set and PCB	£4·52

GUITAR SUSTAIN (P.E. Oct 77)

Maintains the natural attack whilst extending note duration.

Component set, PCB and foot switches	£5·13
Component set, PCB and panel switches	£3·71

WIND AND RAIN UNIT

A manually controlled unit for producing the above-named sounds.

Component set (incl. PCB)	£4·26

GUITAR OVERDRIVE UNIT (P.E. Aug. 76)

Sophisticated, versatile Fuzz unit, including variable and switchable controls affecting the fuzz quality whilst retaining the attack and decay, and also providing filtering. Does not duplicate the effects from the Guitar Effects Pedal and can be used with it and with other electronic instruments.

Component set using dual slider pot	£7·58
Component set using dual rotary pot	£6·89
Printed circuit board	£1·62

FUZZ UNIT

Simple Fuzz unit based upon P.E. "Sound Design" circuit.

Component set (incl. PCB)	£2·05

TREMOLO UNIT

Based upon P.E. "Sound Design" circuit.

Component set (incl. PCB)	£2·94

TREBLE BOOST UNIT (P.E. Apr. 76)

Gives a much shriller quality to audio signals fed through it. The depth of boost is manually adjustable.

Component set (incl. PCB)	£2·51

P.E. TUNING FORK (P.E. Nov. 75)

Produces 84 switch-selected frequency-accurate tones. A LED monitor clearly displays all beat note adjustments. Ideal for tuning acoustic or electronic musical instruments.

Main component set (incl. PCB)	£14·93
Power supply set (incl. PCB)	£6·28

New Electronic Piano.
Elektor Aug. 1978
Details in our list.

CONSTANT DISPLAY FREQUENCY METER (PE AUG 78)

5-digit frequency counter for 1Hz to 99999Hz with a 1Hz sampling rate. Readout does not count visibly or flicker due to display blanking.

Component set	£24·05*
Printed circuit board	£3·03*

*This kit & PCB are at 8% VAT (all others are 12½%)

TAPE NOISE LIMITER

Very effective circuit for reducing the hiss found in most tape recordings. All kits include PCBs

Standard tolerance set of components	£2·96
Superior tolerance set of components	£3·76
Regulated power supply (will drive 2 sets)	£4·69

ENVELOPE SHAPER WITHOUT VCA (P.E. Oct. 75)

Provides full manual control over attack, decay, sustain and release functions, and is for use with an existing voltage controlled amplifier.

Component set (incl. PCB)	£4·77

ENVELOPE SHAPER WITH VCA (P.E. Apr. 76)

This unit has its own voltage controlled amplifier and has full manual control over attack, decay, sustain and release functions.

Component set (incl. PCB)	£6·68

TRANSIENT GENERATOR (P.E. Apr. 77)

An envelope shaper, without VCA, having the usual attack, decay, sustain and release functions, and in addition it also provides a "Repeat Effect" enabling a synthesiser to be programmed to imitate such instruments as a mandolin or banjo.

Component set	£4·87
Printed circuit board	£1·82

WAVEFORM CONVERTER

Slightly modified from a circuit published in "Elektor". Converts a saw-tooth waveform into four different waveforms: sine-wave, mark-space saw-tooth, regular triangle form, and squarewave with an externally variable mark-space ratio.

Component set (incl. PCB but excl. sw/s)	£8·40

VOLTAGE CONTROLLED FILTER (P.E. Dec. 74)

Part of the P.E. Minisonic now released as an independent kit for use with other synthesisers.

Component set (incl. PCB) (Order as Kit 65-1)	£7·17

RING MODULATOR (P.E. Jan. 75)

Part of the P.E. Minisonic now released as an independent kit for use with other synthesisers.

Component set (incl. PCB) (Order as Kit 59-1)	£5·50

NOISE GENERATOR (P.E. Jan. 75)

Part of the P.E. Minisonic now released as an independent kit for use with other synthesisers.

Component set (incl. PCB) (Order as Kit 60-1)	£3·64

SOPHISTICATED POWER SUPPLIES

A wide range of highly stabilised low noise power supply kits is available—details in our lists.

MICROPHONE PRE-AMP (P.E. Apr. 77)

Component set (incl. PCB)	£3·82

VOICE OPERATED FADER (P.E. Dec. 73)

For automatically reducing music volume during "talk-over"—particularly useful for Disco work or for home-movie shows.

Component set (incl. PCB)	£3·97

DYNAMIC RANGE LIMITER (P.E. Apr. 77)

Automatically controls sound output to within a preset level.

Component set (incl. PCB)	£4·58

POST AND HANDLING

U.K. orders—under £15 add 25p plus VAT, over £15 add 50p plus VAT. Keyboards £2·00 plus VAT.

Optional Insurance for compensation against loss or damage in post, add extra 50p for cover up to £50, £1·00 for £100 cover, £2·00 for £200 cover.

Eire, C.I., B.F.P.O., and other countries are subject to Export postage rates.

DON'T FORGET VAT!

Add 12½% (or current rate if changed) to full total of goods, post and handling. (Does not apply to export orders).

EXPORT ORDERS are welcome, though we advise that a current copy of our list should be obtained before ordering as it also shows Export postage rates. All payments must be cash-with-order, in Sterling and preferably by International Money Order or through an English Bank. To obtain list send 50p.

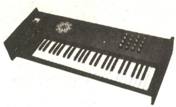
PHONOSONICS · DEPT. PE6N · 22 HIGH STREET · SIDCUP · KENT DA14 6EH MAIL ORDER AND C.W.O. ONLY SORRY BUT NO CALLERS PLEASE

ND OTHER PROJECTS

PHOTOGRAPHS in this advertisement show two of our units containing some of the P.E. projects built from our kits and PCBs. The cases were built by ourselves and are not for sale, though a small selection of other cases is available.

LIST—Send stamped addressed envelope with all U.K. requests for free list giving fuller details of PCBs, kits and other components.

OVERSEAS enquiries for list: Europe—send 20p: other countries—send 50p.



KIMBER-ALLEN KEYBOARDS AND CONTACTS

Kimber-Allen Keyboards as required for many published circuits. The manufacturers claim that these are the finest moulded plastic keyboards available. All octaves are C to C, the keys are plastic, spring-loaded, fitted with actuators, and mounted on a robust aluminium frame.

3 Octave (37 notes)	**£25·50**
4 Octave (49 notes)	**£32·25**
5 Octave (61 notes)	**£39·75**

Contact Assemblies (gold-clad wire) for use with the above keyboards (1 required for each note):

Type GJ: Single-pole change-over	each **25½p**
Type GB: 2 pairs of contacts, each pair normally open	each **28½p**
Type GC: 3 pairs of contacts, each pair normally open	each **37½p**
Type GE: 4 pairs of contacts, each pair normally open	each **46½p**
Type GH: 5 pairs of contacts, each pair normally open	each **58½p**
Type 4PS: 3 pairs of contacts plus single-pole changeover	each **57p**

Printed Circuit Boards for use with GJ, GB and 4PS contacts (thus eliminating much interwiring) are available. Details in our lists.

RHYTHM GENERATOR

15-Rhythm Tempo, Timing and Logic control unit (excl. sw's but incl. PCB)	**£9·75**
10-Instrument Effects circuits	**£14·23**
PCB for Effects circuits	**£4·25**
Power Supply incl. PCB	**£8·75**

128-NOTE TUNE-PROGRAMMABLE SEQUENCER

(P.E. Nov/Dec 77)

Enables a voltage controlled synthesiser to automatically play pre-programmed tunes of up to 32 pitches and 128 notes long. Programs are keyboard initiated and note length and rhythmic pattern are externally variable. (Please use order codes quoted in brackets.)

Main Circuit (Nov) excl. sw's (KIT 76-1)	**£18·03**
Power Supply (KIT 76-3)	**£4·72**
Trigger Inverter and Alt. Output (KIT 76-2)	**£1·15**
LED Counter (KIT 76-4)	**£2·10**
PCB (as published) for KITS 76-1 & 3 (PCB 76A)	**£2·61**
PCB for KITS 76-2 & 4 (PCB 76B)	**£2·54**

P.E. STRING ENSEMBLE (PE Mar-July 78)

The new keyboard string-instrument synthesiser.

Basic component sets:

Power Supply (KIT 77-1)	**£8·77**
Tone Generator (KIT 77-2)	**£14·66**
Diode Gates (KIT 77-3)	**£18·81**
Chorus Generator (KIT 77-4)	**£19·08**
Voicing System (KIT 77-5)	**£7·38**

Printed Circuit Boards:

Double-sided PCB for Power Supply, Tone Generator & Diode Gates with most of the Matrix wiring as printed tracking (PCB 77L/R)	**£18.40**
PCB for Chorus Generator (PCB 77C)	**£2.65**
PCB for Voicing System (PCB 77D)	**£2.62**

Fuller details of kits & PCBs are in our lists.

FORMANT SYNTHESISER (Elektor 1977/78)

Very sophisticated music synthesiser for the advanced constructor who puts performance before price. Details in our lists.

DISCOSTROBE (P.E. Nov. 76)

4-channel light-show controller giving a choice of sequential, random, or full strobe mode of operation.

Basic component set	**£18·19**
Printed circuit board	**£3·45**

BIOLOGICAL AMPLIFIER (P.E. Jan./Feb. 73)

Multi-function circuits that, with the use of other external equipment, can serve as lie-detector, alphaphone, cardiophone etc.

Pre-Amp Module Components set (incl. PCB)	**£3·95**
Basic Output Circuits—combined component set with PCBs, for alphaphone, cardiophone, frequency meter and visual feed-back lampdriver circuits.	**£6·59**
Audio Amplifier Module Type PC7	**£7·75**

10% DISCOUNT VOUCHER (PE6N)

TERMS: Correctly costed, C.W.O., U.K. orders over **£50** goods value. Valid until end of month on cover of P.E. This voucher must accompany order.

TRANSISTORS

AC128	**32p**
AC176	**28p**
BC107	**13p**
BC108	**13p**
BC109	**15p**
BC109C	**16p**
BC177	**18p**
BC184	**11p**
BC187	**18p**
BC204	**10p**
BC209C	**13p**
BC213	**11p**
BC214	**11p**
BC262	**18p**
BC415	**15p**
BC478	**15p**
BD131	**60p**
BD132	**44p**
BF244A	**32p**
BF245A	**38p**
BSY95A	**22p**
MD8001	**210p**
OC71	**20p**
OC72	**30p**
RPY58A	**62p**
TIS43	**50p**
ZTX108	**7½p**
ZTX301	**13p**
ZTX384	**12p**
ZTX501	**13p**
2N2219	**28p**
2N2646	**70p**
2N2905	**28p**
2N2905A	**29p**
2N2906	**22p**
2N2907	**24p**
2N3054	**68p**
2N3055	**76p**
2N3702	**12p**
2N3704	**12p**
2N3819	**24p**
2N3820	**61p**
2N3823E	**39p**
2N5459	**45p**

INTEGRATED CIRCUITS

301	8-pin DIL	**48p**
318	8-pin DIL	**220p**
320-15	---	**195p**
324	14-pin DIL	**87p**
341-15	---	**87p**
709	8-pin DIL	**48p**
723	T05	**87p**
723	14-pin DIL	**51p**
726	T05	**1005p**
741	8-pin DIL	**24p**
748	8-pin DIL	**57p**
4007	14-pin DIL	**17½p**
4011	14-pin DIL	**17½p**
4024	14-pin DIL	**46½p**
4069	14-pin DIL	**18p**
4136	14-pin DIL	**126p**
AM2833	8-pin DIL	**360p**
AY10212	16-pin DIL	**617p**
AY16721/6		**188p**
CA3046	14-pin DIL	**71p**
CA3080	8-pin DIL	**63p**
CA3084	14-pin DIL	**209p**
FX209	16-pin DIL	**729p**
LM323	---	**562p**
M252	16-pin DIL	**680p**
MC3340	8-pin DIL	**150p**
MCM6810	24-pin DIL	**670p**
SG3402N	14-pin DIL	**262p**
STK025	---	**595p**
TDA1022	16-pin DIL	**582p**
XR2207	14-pin DIL	**420p**
ZN425E	16-pin DIL	**375p**

PRICES ARE CORRECT AT TIME OF PRESS.
E. & O. E. DELIVERY SUBJECT TO AVAILABILITY.

PHONOSONICS

Wilmslow Audio

THE firm for speakers!

SEND 15p STAMP FOR THE WORLD'S BEST CATALOGUE OF SPEAKERS, DRIVE UNITS, KITS, CROSSOVERS, ETC. AND DISCOUNT PRICE LIST

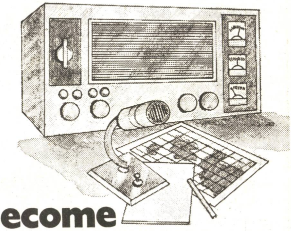
ACT ● AUDAX ● BAKER
BOWERS & WILKINS ● CASTLE ● CELESTION
CHARTWELL ● COLES ● DALESFORD
DECCA ● EMI ● EAGLE ● ELAC ● FANE
GAUSS ● GOODMANS ● HELME ● I.M.F.
ISOPHON ● JR ● JORDON WATTS
KEF ● LEAK ● LOWTHER ● McKENZIE
MONITOR AUDIO ● PEERLESS ● RADFORD
RAM ● RICHARD ALLAN ● SEAS
TANNOY ● VIDEOTONE ● WHARFEDALE

WILMSLOW AUDIO (Dept. P.E.)
SWAN WORKS, BANK SQUARE, WILMSLOW,
CHESHIRE SK9 1HF

Discount Hi-Fi, etc. at 5 Swan Street and 10 Swan Street

Tel.: Wilmslow 29599 for Speakers Tel.: Wilmslow 26213 for Hi-Fi

---



Become a radio amateur.

Learn how to become a radio-amateur in contact with the whole world. We give skilled preparation for the G.P.O. licence.

WAA

Free!

Brochure, without obligation to:

BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL, PEK11
P.O.Box 156, Jersey, Channel Islands.

NAME ____________________

ADDRESS ____________________ **(Block caps please)**

WIRE WRAPPING CENTRE

HOBBY WRAP
Model BW 630

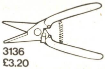
Battery Wire-Wrapping Tool Complete with Bit and SI Line

WIRE-WRAPPING TOOL
For .025" (0,63mm) sq. post "MODIFIED" wrap, positive indexing, anti-overwrapping device.

A	For AWG 30	BW-630
B	For AWG 26-28	BW-2628
C	Bit for AWG 30	BT-30
D	Bit for AWG 26-28	BT-2628

A£24.77 B£29.58 C£2.61 D£6.89

3 IN 1 WIRE DISPENSER
New wire dispenser cuts and strips three different colours of wire. Quick and easy to use pocket size.
£3.77



3136
£3.20

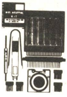
OK PLIERS AND CUTTERS
UNIVERSAL CUTTER
Cuts everything. Leather, wire, plastic, tin-plate, cardboard. Stainless steel blades.
Just one of the range of high quality pliers, cutters, tweezers and screwdrivers.

DIP/IC EXTRACTOR TOOL £1.18
The EX-1 Extractor is ideally suited for hobby enthusiast or lab engineer. Featuring one piece spring steel construction. It will extract all LSI, MSI and SSI devices of from 8 to 24 pins.
Extractor Tool EX-1.

DIP/IC INSERTION TOOL WITH PIN STRAIGHTENER

£2.58

INS-1416



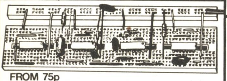
WIRE-WRAPPING KIT
Contains: Hobby Wrap Tool WSU-30 M, Wire Dispenser WD-30-B, (2) 14 DIP's, (2) 16 DIP's, Hobby Board H-PCB-1, DIP/IC Insertion Tool INS-1416 and DIP/IC Extractor Tool EX-1.

Wire-Wrapping Kit	WK-4B (Blue)

£ 17.82

- Solve probe attachment problems.
- Simplify prototype and production testing, field service work, and quality control.

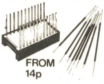
IC TEST CLIPS £2.77
FOR DUAL-IN-LINE PACKAGES
- Provide full access to integrated circuit DIP leads.
- Remove DIP's damage free.
- Available in sizes to accommodate all DIP's; TC-14 fits 14-pin DIP's etc.



FROM 75p
TERMINAL AND DISTRIBUTION STRIPS
Bread boarding building blocks with universal matrices of solderless plug-in tiepoints.
- Facilitate quick, solderless circuit build-up and check-out on universal .1" x .1" matrix.
- Are offered in ten configurations.
- Accept all components with leads up to .032" diameter.
- Require no special patch cords.
- Includes integral non-shorting instant mounting backing.

HOBBY WRAP TOOL
Wire-wrapping, stripping, unwrapping tool for AWG 30 on .025 (0,63mm) Square Post.
A£4.39 B£4.69

Regular Wrap	A	WSU-30
Modified Wrap	B	WSU-30M



FROM
14p

DIP SOCKET
Dual-in-line package, 3 level wire-wrapping, phosphor bronze contact, gold plated pins . 025 (0,63mm) sq., .100 (2,54mm) centre spacing.

14 Pin Dip Socket	14 Dip
16 Pin Dip Socket	16 Dip

RIBBON CABLE ASSEMBLY £2.40

With 14 Pin Dip Plug - 2" Long	DE 14-2
With 14 Pin Dip Plug - 4" Long	DE 14-4
With 14 Pin Dip Plug - 8" Long	DE 14-8
With 16 Pin Dip Plug - 2" Long	DE 16-2
With 16 Pin Dip Plug - 4" Long	DE 16-4
With 16 Pin Dip Plug - 8" Long	DE 16-8

DISTRIBUTORS WANTED***

OK Machine&Tool U.K. Limited
48a The Avenue·Southampton SO1 2SY
Telephone Southampton (0703) 38966/7 Telex 477222 Cablegram OKMAC

DISTRIBUTORS WANTED***

CANON COMPONENTS

Low Imp Dynamic Mic's Brand new in packs **£1.62**
Triacs 10 amp 400v brand new AEI full spec. all with fitted heavy duty heat sink **£2.55**
TAG. 202A 400 1 amp triacs **£1.00**
302 400 1 amp triacs **£1.00**
22 way edge connectors Ex equipment but clean 0.15 matrix gold plated complete with locating pin **Only 58p**
17 way edge connectors Brand new .15 pitch complete with locating pin and fixing brackets. Tinned. **Only 35p**
Loudspeaker columns Type A. 6′ 6″ Tall with cut-outs for 8″ × 5″ Speakers and Motorola tweeters. **Only £16.50 each.** Ideal for P.A. work or discos.
SPECIAL CAPS OFFER LECTROFLASH Photoflash caps, ideal for strobes or the serious photographer. All brand new.
200uf at 500vdc **each £1.60**
400uf at 500vdc **each £2.00**
2500uf at 70vdc **each £1.60**
100 + 500uf at 250vdc **each £3.00**
IMCO AC working cap 16uf ± 5% at 500v **only £3.00 each**
Felsic Computer grade caps for your power amp 3900uf at 100v **each £2.20**
Caps by G.E. 1400uf at 200vdc. Screw terminals **each £1.85**
Smooth out granny with 83,500uf at 45vdc 60v surge computer grade **each £3.50**
Connecting wire 15p per 10 metres or mixed at **£3.00 per kilo approx.**
Tagstrips 30 way new. **15p**
Group Board 17 or 34 way brand new **12p and 24p**
Meters 1 ma meters ex-equipt but in terrific condition **£3.20**

Transformers All with 110-240v ac primarys.
24vac @ 10 amps. **£7.50 inc** (open const)
9vac @ 3 amps. **£3.80 inc** (clamp const)
240v in. 15-0-15 @ 2 amps. **£3.55 inc** (clamp const)
13vac @ 3amp 15vac @ 1 amp **£6.80 inc** (C core const)
Toroid 240vac in 35v @ 4 amps **£12.00 inc** (potted toroid)
240vac in 12v-12v-40v @ .5a .5a 4 amps **only £7.50 each**
240vac in 12v-40v at .5a and 2.5 amps **only £6.50 each**
240vac in 35-0-35 at 4 amps only **£7.04 each**
240vac in 6.3v at 10 amps **£6.50 each**

DIAL-A-BOX

As featured in "P.E. MARKET PLACE" a comprehensive standard range of boxes for the constructor, or custom built to your specification. Send your requirements with S.A.E. or phone for quote..

Linears and Transistors We hold comprehensive stocks of most popular types at realistic prices eg:– LM 380 complete 2.5 watt amplifier. **85p each.** Suitable etched tinned pcb **£1.00.** Components for same **£1.20 set**
BC 212L **only 8p each**
BC 148 (plastic bc108) **8p**
BC148c **10p**
BC 149 **10p** (plastic bc109)
BC 158 **10p**
Photo-opto couplers **£1.00**
Complete semi-conductor lists to follow.
Solenoids 12 Volt DC operation, ideal for door locking-lock release. Mainly ex-equipment these are all guaranteed working order and complete with steel mounting frame. **Only £2.80**

Magnetic Disc Recorders Few only left of these units which provide an ideal basis for magnetic disc echo or multiple recording. **Only £5.50**
Wooden Cases Size approx 14″ × 5″ × 9″ finished in dark oak colour ideal for use as amplifier case, small loudspeaker case, baby alarm amp **Only 75p**
I/C socket panels with over 60 ic sockets fitted, mainly 14 pin easily removed with a blowtorch from rear. **Only £2.50**
Lamp panels with over thirty lampholders fitted ideal for light displays or moving light shows. **Only 85p**
Power Supply Unit Complete ready to go. Ex-equipment but guaranteed in working order. Delivers 5v and 7.5v at up to 10 amps total. 240v primary **Only £5.50**
Relay TV converters ex relay service so no guarantee but ideal break-down units containing a host of RF components including a **TV modulator** if's caps etc; **Only £2.75**
ISKRA 3 speed record decks. Single players with specially wound motor for 240v and separate winding giving 14v for deck amplifier. **Only £6.85**
Plenty of spares for ISKRA decks. **Arms £1.00. Turntables £1.00** etc.
Barrier Strips 3 way **10p each** or **10 for 60p**
Solda-tag packs Approx 50 assorted single, double, rivet type, all sizes. **25p per pack**
ALI-Packs All sizes of off-cuts ideal for that odd job **25p**
Self Adhesive cabinet feet 4 for **15p**
PSU Hearts twin heatsink with rectifier two caps, two high wattage resistors and other components. **Only 35p**
Terminal strips 16 way similar to barrier strips **38p each**
Triac operated mains timer in perspex box all in original wrapping **£1.05 each**
Mains selector panels from 200v-250v. Brand new. **20p each**
Cable Ties long re-usable 6″ plus. **3p each.**
Double sided sticky tape in 6″ strips with easy tear ends **5p each**
'P' Clip packs 30p each
I.C. packs all types, many with original markings very cheap **£1.20**

All prices include VAT – Please add 35p Post & Packing to total cost of order.
Open daily 9.30am-6pm – Access or Barclaycard accepted – S.A.E. for lists.

322-324 WHITEHORSE ROAD, CROYDON, SURREY CRO 2LF TEL 01-684 9872

UNDERSTANDING DIGITAL ELECTRONICS

by Texas Inst. Price: **£3.95**

CHEAP VIDEO COOKBOOK
by D. Lancaster Price: **£6.95**

BEGINNER'S GUIDE TO MICROPROCESSORS by C. M. Gilmore Price: **£4.85**

MINIPROCESSORS FROM CALCULATORS TO COMPUTERS by D. L. Heiserman Price: **£4.85**

REPAIRING POCKET TRANSISTOR RADIOS
by I. R. Sinclair Price: **£2.50**

USING DIGITAL AND ANALOG INTEGRATED CIRCUITS by L. W. Shacklette & H. A. Ashworth Price: **£8.50**

HOW TO BUILD YOUR OWN STEREO SPEAKERS by C. Robin Price: **£12.00**

WORLD DX GUIDE
by J. Vastenhoud Price: **£5.30**

OP-AMP CIRCUIT DESIGN & APPLICATIONS by J. Carr Price: **£4.00**

FOUNDATIONS OF WIRELESS AND ELECTRONICS 9th ED. by M. G. Scroggie Price: **£4.25**

DESIGN TECHNIQUES FOR ELECTRONICS ENGINEERS Price: **£11.60**

* ALL PRICES INCLUDE POSTAGE *

THE MODERN BOOK CO.

BRITAIN'S LARGEST STOCKIST
of British and American Technical Books

19-21 PRAED STREET
LONDON W2 1NP

Phone 01-723 4185
Closed Saturday 1 p.m

PE VOLUME 14 No. 15 NOVEMBER 1978

MORE RAM

WE HAVE heard plenty about the 64K RAM over the last few months—so much that we hesitate to mention it again—however, it was only a couple of months ago that everyone was contemplating the government proposals and wondering if a sponsored company would be competitive. We have today received news of a Texas TMS 4164 which is—you've guessed it—a 64K RAM. This new device comes in a standard 16 pin d.i.l. package and is expected to be available in sample quantities towards the end of the year; volume production early 1979—where were we?

It is interesting to note that the photomasks for volume production will be made using electron-beam equipment. It has been stated that the 64K RAM is probably as far as we can go using the present production methods, this does not however mean that we are about to come to the end of further miniaturisation.

THE BUBBLE BURSTS!

New technologies are always coming along. One that we heard much of a few years ago was the discovery of magnetic bubbles and how they would effect the whole electronics industry. Well they haven't, have they? But wait, development of such things takes time and the bubble is just about to burst.

It seems that far from being contented with a probable first in the 64K RAM area, Texas have also been playing with a few bubbles. A few did we say, the TIB0303 92k bit bubble memory will soon be available. This device contains 252 minor loops each with 1137 bubble positions! Of course this takes up more room than the regular 64K semiconductor device and is therefore mounted in a 20 pin d.i.l. package! Can we go on believing it's all possible? (More details on this bubble memory can be found on page 1170.)

We find it harder to accept the fact that the quarter million bit bubble chip is with us than that 100,000 active elements can be put on a silicon chip. This is probably because we tend to think of bubbles as having a relatively large minimum size, whereas we hardly had time to accept the transistor before it became integrated. We must look at bubbles again.

COMPONENT COUNT

Dr. Robert R. Heikes, Vice President of Motorola Inc. and Assistant General Manager Semiconductors Group, speaking at a recent press conference made the following statement:

"By the early 1980's, we will no doubt see the routine production of integrated circuits containing at least 100,000 active elements per chip, and by the mid-80's, that device count will reach an incredible one million components on a chip no larger than one-quarter of an inch square; or several billionths (*American billionths that is—Ed.*) of a square inch per device.

With this degree of chip density, it is perfectly logical to assume that we will see the development, for example, of a product no larger than a hand-held calculator that will contain the computing power of today's largest main-frame computer. That's obviously a tremendous amount of computing capability."

It has been calculated that theoretically 10,000,000 components per chip might be achievable and, at the rate things are progressing (generally speaking the chip count has been doubling every year since the sixties), this will only take to the end of the eighties. What then? Many will say we will have gone far enough by then, but history tells us that we will continue to progress.

Mike Kenward

EDITOR

Mike Kenward
Gordon Godbold ASSISTANT EDITOR
Mike Abbott TECHNICAL EDITOR
Alan Turpin PRODUCTION EDITOR
David Shortland TECH. SUB EDITOR
Jack Pountney ART EDITOR
Keith Woodruff ASSISTANT ART EDITOR
John Pickering SEN. TECH. ILLUSTRATOR
Isabelle Greenaway TECH. ILLUSTRATOR
Judith Kerley SECRETARY

Editorial Offices:
Westover House,
West Quay Road, Poole,
Dorset BH15 1JG
Phone: *Editorial* Poole 71191

We regret that lengthy technical enquiries cannot be answered over the telephone.

Advertising Offices:
King's Reach Tower,
King's Reach, Stamford Street, SE1 9LS
Phone: *Advertisements* 01-261 6676
Telex: 915748 MAGDIV-G

ADVERTISEMENT MANAGER

D. W. B. Tilleard
P. J. Mew REPRESENTATIVE
C. R. Brown CLASSIFIED MANAGER

Make Up/Copy Dept.: 01-261 6601
Classified: 01-261 5762

Technical Queries

We are unable to offer any advice on the use or purchase of commercial equipment or the incorporation or modification of designs published in Practical Electronics.

All letters requiring a reply should be accompanied by a stamped, self addressed envelope and each letter should relate to **one published project only.**

Components are usually available from advertisers; where we anticipate supply difficulties a source will be suggested.

Back Numbers

Copies of most of our recent issues are available from: Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF, at 75p each including Inland/Overseas p & p.

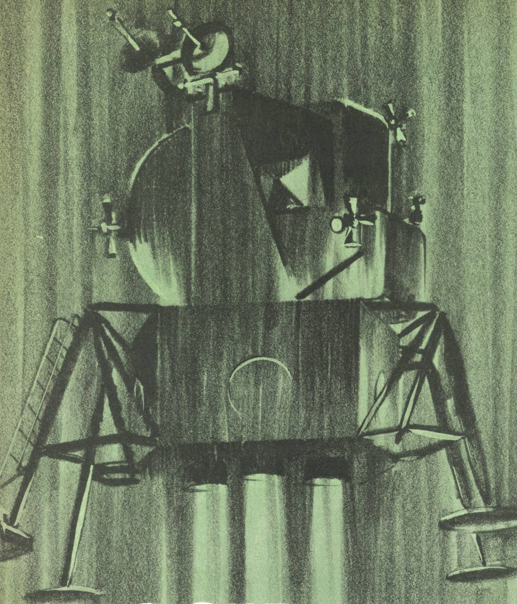
Binders

Binders for PE are available from the same address as back numbers at £2·85 each to UK addresses, £3·45 overseas, including postage and packing, and VAT where appropriate. Orders should state the year and volume required.

Subscriptions

Copies of PE are available by post, inland or overseas, for £10·60 per 12 issues, from: Practical Electronics, Subscription Department, Oakfield House, Perrymount Road, Haywards Heath, West Sussex RH16 3DH.

Cheques and postal orders should be made payable to IPC Magazines Limited.



MOON LANDING GAME

A. RUSSELL

AT the controls of this game you can land your own space ship on the Moon and test your skill and timing by guiding the rocket to a safe landing before the fuel runs out.

Moon Landing is essentially a hard wired analogue computer which simulates approximately the dynamics of a space craft landing on the Moon. Additional circuitry monitors the computer and switches off the rocket motor when the fuel runs out, indicates when the craft has landed, and shows when a safe landing velocity is achieved.

Playing the *Moon Landing* game gives children a feel for the concepts of distance, velocity and acceleration and the relationships between them. Thus as well as being fun to play it also has an educational value.

CONTROLLED DESCENT

You are pilot of the first British expedition to the Moon. At one minute before touchdown the flight control computer blows a fuse, leaving you to land under manual control. There is a lever to control rocket motor thrust and a meter which can be switched to read velocity, height or fuel reserves. Your object is to achieve touchdown at a safe landing speed.

Two lights are provided; one tells you that you have landed and the other indicates whether or not the touchdown was at a safe velocity. Therefore when both lights are on together you have completed a successful landing.

A "Panic" button is provided. In the event of fuel running out before landing (because of a bit of ham fisted driving on the part of the pilot) it will divert the contents of the medicinal whisky tank into the rocket fuel tanks, giving an extra 15 per cent fuel.

SCHEMATIC

The analogue computer in *Moon Landing* represents a simplified view of a space craft landing on the Moon. No account is taken of the changing mass of the rocket as it burns fuel or changing gravitational attraction, etcetera.

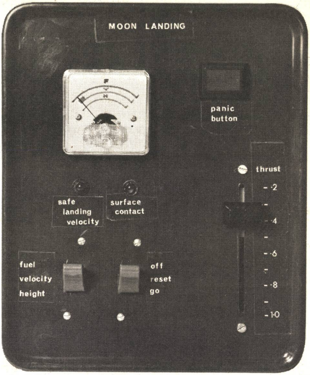
A schematic diagram of the game is shown in Fig. 1. It is not intended to explain in detail the theoretical background of integral calculus and analogue computers. Those interested in finding out more could start by reading the "Analogue Computer" series currently running.

In Fig. 1, the value of thrust selected by the pilot is fed into Integrator 1 which calculates the total quantity of fuel used. When fuel runs out a level detector switches off the thrust. A "Panic" switch feeds more fuel into the fuel tank when it is pressed. Thrust from the rocket engines is added to Moon gravity to give total acceleration acting on the ship. Integrator 2 calculates the resulting velocity and a level switch lights the "Safe Landing Velocity" light when the downward velocity of the space craft falls below a certain value. Velocity is integrated by Integrator 3 to give space craft height and another level switch detects when this is zero to light the "Surface Contact" light.

CIRCUIT

The circuit diagram is shown in Fig. 2. Switch S2 has three positions. In the "Off" position power is disconnected from the circuit. In the "Reset" position capacitors in each integrator are charged to +5·1V to fill the fuel tanks (Integrator 1), give the rocket a large downward velocity (Integrator 2) and set the initial height above the Moon (Integrator 3).

When S2 is moved into the "Go" position the analogue computer starts its calculation. Slider pot VR1 ("Thrust") controls the voltage across R4. This voltage is fed into Integrator 1 (IC1) through R3. Output voltage of IC1 falls at a rate determined by the voltage across R4 (the "Thrust" setting) until point A goes sufficiently negative to forward



Control panel layout

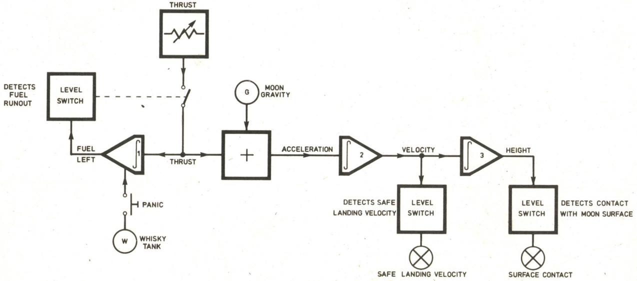


Fig. 1. Schematic diagram

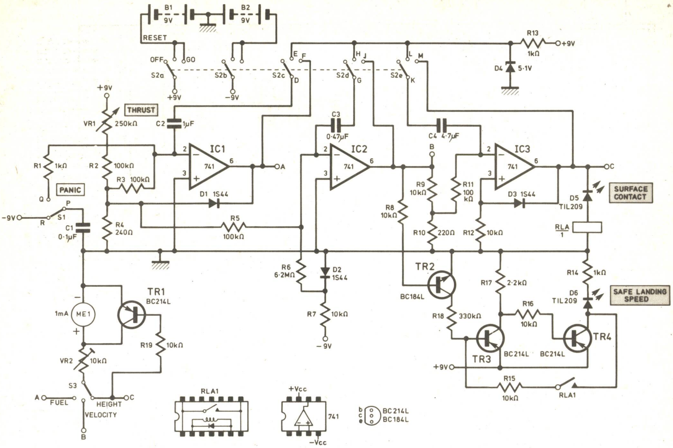


Fig. 2. ***Moon Landing*** **circuit**

COMPONENTS . . .

Resistors

R1	1kΩ	R11	100kΩ
R2	100kΩ	R12	10kΩ
R3	100kΩ	R13	1kΩ
R4	240Ω	R14	1kΩ
R5	100kΩ	R15	10kΩ
R6	6·2MΩ	R16	10kΩ
R7	10kΩ	R17	2·2kΩ
R8	10kΩ	R18	330kΩ
R9	10kΩ	R19	10kΩ
R10	220Ω		

All resistors $\frac{1}{8}$ watt 5% carbon

Capacitors

C1	0·1µF
C2	1µF
C3	0·47µF
C4	4·7µF

All capacitors polyester

Diodes

D1	1S44
D2	1S44
D3	1S44
D4	5·1V Zener
D5–D6	TIL209 (2 off)

Transistors

TR1	BC214L
TR2	BC184L
TR3	BC214L
TR4	BC214L
IC1	741
IC2	741
IC3	741

Potentiometers

VR1	250kΩ slider pot
VR2	10kΩ trimmer pot

Switches

S1	s.p.d.t. push-button
S2	PO type 1000 lever switch
S3	PO type 1000 lever switch

Miscellaneous

ME1 1mA meter. B1 and B2 PP3 batteries and suitable connectors. RLA d.i.l. reed relay 500Ω coil 3·7–10V operation. Veroboard, suitable plastic case, nuts and bolts, etc.

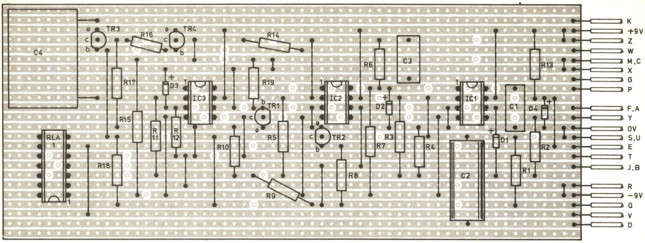


Fig. 3. **Veroboard component layout**

bias D1. Current drawn through D1 reduces the voltage across R4 to zero and effectively switches off the thrust.

If the "Panic" button is pressed, charge on capacitor C1 is fed into Integrator 1 which increases the voltage at A by about +0·9V thus adding to the fuel reserves.

The voltage across R4 is also fed into Integrator 2 (IC2) along with the effect of gravity (voltage across D2). These two inputs represent the accelerations acting upon the space craft and the output of Integrator 2 is the resulting velocity.

This output is monitored by TR2 which forms the "Safe Landing Velocity" level switch. When the voltage at B is above +0·5V, TR2 is biased on and feeds current into the base of TR3, via R18, which also switches on.

TR3 collector voltage is about +9V when it is switched on and so no current can flow through R16 to switch on TR4. D6 is therefore off. As the voltage at point B falls below +0·5V TR2 switches off and so TR3 also switches off. TR3 collector voltage becomes more negative, current flows into TR4 base, switching it on and lighting D6. When the relay pulls in upon landing, TR3 and TR4 are connected into a bistable circuit, by feedback through R15, which remembers the condition of D6 at the instant of landing.

The voltage at B ("Velocity") is fed through a potential divider R9 and R10 and then into Integrator 3 (IC3) which calculates the space craft height. When the voltage at C ("Height") falls to about −0·4V ("Surface Contact") diode D3 becomes forward biased and current flows through R12. The resulting voltage across R12 appears on the non inverting input of IC3 and is amplified in a positive feedback loop which forces the output of IC3 to −9V. D5 becomes forward biased and lights ("Surface Contact") and the relay is energised which latches D6 into the state it was in when the rocket landed.

METERING

The meter ME1 may be switched by S3 to read "Fuel", "Velocity" or "Height". When the voltage at C switches to −9V on landing, TR1 is switched on and shorts out the meter so that all readings fall to near zero on landing.

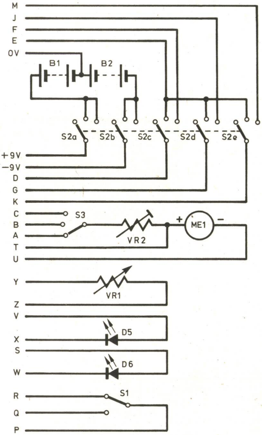
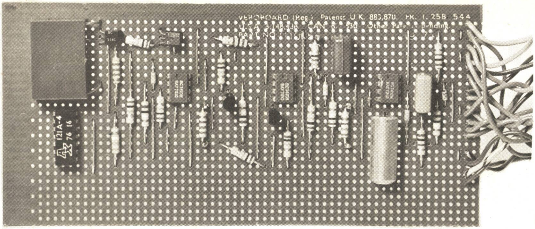
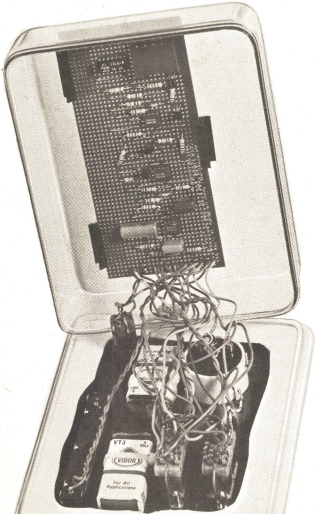


Fig. 4. **Control panel wiring to Veroboard**





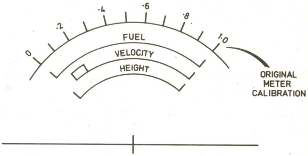


Fig. 5. Rescaling an existing milliammeter

CONSTRUCTION

The Veroboard layout of the *Moon Landing* circuit is shown in Fig. 3 and should present no constructional difficulties. Connections between the Veroboard circuit and the switches, l.e.d.s, etc. are shown in Fig. 4. These components are all mounted on the front panel. A plastic sandwich box was used to house the complete game and the layout chosen for the front panel controls is shown in the photograph.

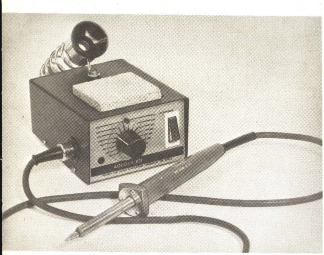
CALIBRATION

The 1mA meter ME1 requires a new scale. Fig. 5 shows the relationship between the original 0–1mA calibration and the new one for fuel, velocity and height. The new scale may be drawn on plain white paper, cut to shape and glued into position. Take great care not to damage the meter movement while taking it apart.

Use the zero adjusting screw on the meter to set the pointer at zero on the velocity scale with the power off. Adjust VR2 to make the initial values (immediately after "Reset") of fuel, velocity and height agree with the new scale. The meter is now calibrated and landing is for "go". ★

Special Offer!

Exclusive to PE Readers



ADCOLA L101

Thermostatically controlled soldering station

£48·95

Recommended Retail Price (including VAT) £61·17

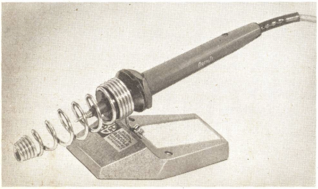
The very latest in soldering iron technology with control of the required temperature within ±2 per cent. Heating range is 120–240°C. Working temperature is reached in less than two minutes. A positive earthing system prevents electrical damage when soldering voltage sensitive devices.

ADCOLA K1000 £6·30

with L686S SAFETY STAND

Rec. Ret. Price (inc. VAT) £8·29

This lightweight thermal balance iron has a short heating element barrel for greater tip control and the Noryl plastic handle remains cool even after extended use. The bit supplied is 4·7mm dia. with a 1mm screwdriver face and other bits are easily fitted. Mains operated, the K1000 comes complete with two metres of three core cable and a solid stand especially designed for these type of irons.



Please complete both parts of the coupon in BLOCK CAPITALS

To: Adcola Products Ltd. (P.E. Offer)
Adcola House, Gauden Road, London SW4 6LH
Please send me the following equipment.

☐ L101 Soldering Station/s at £48·95 (inc. p&p)

☐ K1000 Iron/s and Stand/s at £6·30 (inc. p&p)

I enclose P.O./Cheque No .... Value ....

Name ....

Address ....

....

....

Tel. No. (Home or Work) ....

Please allow 28 days for delivery.

OFFER ENDS FRIDAY DECEMBER 15.

Name ....

Address ....

....

....

From: Adcola Products Ltd. (P.E. Offer)
Adcola House, Gauden Road, London SW6 6LH

SPACEWATCH

FRANK W. HYDE

SPECIAL GERMAN SATELLITE

A satellite is being built at the Max Planck Institute for Extraterrestrial Physics near Munich. It will contain sub-satellites made in Britain, Germany, USA and, it is hoped, the Soviet Union. The main portion is the Firewheel Satellite. It will perform like a firecracker when it begins its special mission.

The satellite will be launched from Kourou in French Guinea. The sub-satellites will eject ionised barium and lithium which will become clouds of plasma. Instruments on the ground, in aircraft and in the satellites will monitor the way in which the plasma is affected by the Earth's magnetic field. This will create similar circumstances that exist in the fusion experiments where a plasma is confined by a magnetic field in a Torus. The great advantage in doing this in space compared with the Earth based laboratory is that in space the plasma will continue to exist for 30 minutes or more, whereas in the laboratory it lasts for only a few seconds.

The satellite will be launched using the Ariane 200 ton vehicle from the new site in Guyana. It is a relatively cheap launch since its work load will last only a few hours. This means a very large saving in equipment and back up facilities. It is an important launch under the auspices of the European Space Agency.

MILITARY WEATHER SATELLITE

A third satellite has been launched by the US Air Force from the Vandenberg base. The satellite which weighs 513kg was put into a circular orbit at 833km by a Thor launcher. This satellite is part of what is known as Block D Integrated Spacecraft System and is part of the Defence Meteorological Satellite programme. These rather special satellites have been designed to operate in the higher radion levels which are expected during the increase of radiation as the sunspot cycle nears maximum. It is heavier than its predecessors.

A particular technological note in respect of these satellites is that the on-board computers eliminate the need for a separate booster guidance system. The computers can also keep the pointing of the vehicle to Earth with an accuracy of 0·1°. Block D can take pictures of the whole of the Earth's surface twice a day. It has a high resolution, both in the visible and infra-red bands, of up to 0·5km. Other facilities carried are an auroral detector, a line scanning radiometer, temperature-moisture sounder and pressure measuring equipment. The weather information is distributed to civilian users as well as the armed services.

TRACKING AND DATA RELAY SATELLITE SYSTEM, TDRSS

An expensive re-design of the TDRSS has been set in motion after a report of the preliminary design review. The report showed that there was a hazard from Soviet interference. Several of the present ground stations will be replaced by two geosynchronous satellites capable of handling television, voice telemetry and scientific data to and from Earth orbiting spacecraft in the next decade.

The new programme was conceived when the fact was realised that the shuttle would demand extensive expansion because of the increase in traffic. NASA decided that the answer was to orbit spacecraft that could collect information and then pass it to selected stations. The report showed that the present designs were vulnerable and could be disabled by Soviet radar.

Western Union is providing $796 million for the design of six of the satellites. NASA will lease two of the satellites for its own communications purposes in late 1980, at the time of the first shuttle launch. The two satellites will operate at 41°W over the Atlantic and 171°W over the central Pacific basin. Engineers were particularly concerned about the vulnerability, and have begun the complete redesign of the integrated circuits and ground facilities to make for immunity.

The present time allowed for data entry is 0·01 sec. As the time to be used in order to avoid interference is of the order of 0·00001 sec, NASA finds itself in dispute with the contractors who claim that this item was not stipulated in the original requirement.

PIONEER VENUS 2

Pioneer Venus 2 made a flawless start on its journey with four special probes to achieve a controlled landing through the atmosphere of Venus and make special observations. These were described in detail in a previous Spacewatch. Pioneer Venus 1 is due to encounter Venus on December 4th. It is the orbiter spacecraft of the mission and will observe Venus 2 as it approaches on December 9th. The probes will be released ahead of the main craft.

The important thing about the Venus 2 is that it is the last of the spacecraft to be launched by an expendable rocket. The next missions will be flown by shuttle techniques, in 1982. That will be the Galileo flight to the planet Jupiter.

Under monitor now there are no less than eight missions. In addition to the Venus encounters on the 4th and 9th of December, there is continuous coverage of Voyager 1 which will fly past Jupiter in March 1979, Voyager 2 will follow in July. Pioneer 11 is due to reach Saturn by September 1979. The Viking orbiter and the landers will continue to report from Mars at least to the end of this year.

TELEOPERATOR RETRIEVAL SYSTEM

NASA have contracted to Martin Marietta the development project for the service work on satellites in orbit. Teleoperator Retrieval System, TRS, is a reusable TV equipped spacecraft which will be used by the crew of the shuttle to deliver and stabilise satellites and when necessary recover them from orbit.

The TRS is a low thrust type of spacecraft which is to be operated by remote control from the shuttle. It is possible to carry it from, and return it to, Earth in the cargo bay. It can, if required, be left in orbit, parked, until it is collected at a later date. From time to time it would be returned to Earth for service.

The shuttle will take the TRS into a low orbit, and an astronaut will operate it by remote control from the Orbiter. A camera mounted on the bow of the vehicle will be the eye for the operating astronaut, enabling him or her to carry out the necessary manoeuvres required for docking with satellites and carrying out any task required.

The TRS has its own guidance control system. It will be able to take itself to higher orbits in order to deliver payloads or deliver them to the shuttle. It is a very exciting step for the new shuttle age.

The TRS chassis, or core as it were, will measure 1·2m by 1·5m. There will be 24 attitude thrusters on its eight corners, three to each corner. With the thrusters, three axis controls will be available, also forward and reverse movements. Up to four 680kg Hydrazine propulsion kits (90cm in diameter and 1·5m long) will each have eight rocket engines.

On the after flight deck of the Orbiter will be the hand controls for the TRS together with the communications and data management equipment, also a television monitor and displays which will allow control of the TRS through all its operations. From here it will be possible to transmit, receive and process telemetry, receive television pictures and to issue commands. A flight unit is scheduled to be delivered by September 1979.

INTELSAT TERMINAL

At Goudji in Chad, the Central African Republic, an Earth satellite station has been installed by Thomson-CSF and CIT-Alcatel. The station is equipped with a 14·5m antenna and can handle telegraph, telex and telephone communications via the Intelsat satellites. After 14 years of operation Intelsat is still expanding.

SPACELAB 2

It is announced that there will not be a British astronaut on the Spacelab 2 mission. Two Britons were short listed but lost place to two Americans. The British pair were Bruce Patchett of the Appleton Laboratory and Keith Strong of the Mullard Space Science Laboratory.

NEXT MONTH

GUITAR SOUND MULTIPROCESSOR

Until now there has been no device which fills the space between foot pedal effects and the incredibly expensive guitar synthesisers. This "bucket brigade" design will fill that gap.

2 RADIO CONTROL PROJECTS

Model out of range? Transmitter failure? Either can result in a crunch. Bring it home unharmed with our fail safe. Also efficient servo driver.

FREE!

CHROMOSONICS
24 Page
CATALOGUE

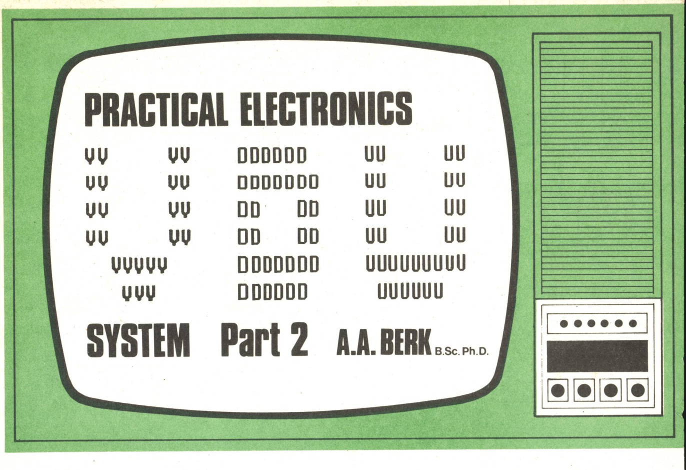
SPECIAL OFFER

10+10 AMPLIFIER KIT

£12·50
INCLUSIVE

PRACTICAL
ELECTRONICS

OUR DECEMBER ISSUE WILL BE ON SALE FRIDAY, 10 NOVEMBER, 1978.



PRACTICAL ELECTRONICS VDU SYSTEM Part 2

A.A. BERK B.Sc. Ph.D.

IN PART 1 of this article, the theory and circuit description of the VDU and its operational characteristics were presented along with a block diagram. In this part, construction, testing and setting up are dealt with. Construction falls readily into two component units: the RAM module and the main p.c.b.

RAM MODULE

The 1K block of RAM is constructed from eight 2102 i.c.s. Each of their ten RAM Address lines (RA1-10) must be connected together from chip to chip (80 interconnections). Similar common lines are required for their power supplies, chip select and R/W lines (a further 32 interconnections). The RAM unit Data-In (DI . . .) and Data-Out (DO . . .) lines are all separate. Conventionally these i.c.s would be placed on an area of p.c.b., with all interconnections being made by fragile narrow copper tracks of minimal spacing (easy to solder–bridge or break) and consuming a considerable area of the board. The RAM module featured in this design drastically reduces the area of p.c.b. required, and the number of interconnections.

Two pieces of 0·1in matrix stripboard are cut to include 8 tracks by 17 holes each, and on one of these boards, 14 cuts are required as shown in Fig. 3(e). The leads of the eight RAM i.c.s must be fully and carefully straightened using a pair of long-nosed pliers (preferably non-serrated). These packages, even in plastic, are very robust and no harm will come to them as long as the pins are bent just once and with the minimum of stress. The pins may then be inserted through the Veroboards into alternate rows of holes *leaving the copper tracks outwards.* One complete row of holes is left free at each end of these boards to use as solder pads for connection to the main p.c.b. Check that the orientation of the chips is such that pins 11 and 12 are fitted into the isolated portions of tracks of Fig. 3(e).

As soon as the i.c.s are in place, a couple of pins on each board should be soldered down to prevent the boards from slipping apart. The soldering should be done as fast as possible with a clean narrow bit, working along one *track* at a time so that successive solder joints are made to different i.c.s. This exposes each element to the minimum build-up of heat. Finally, the bottom two tracks (holding pins 8 and 9 of the i.c.s) are soldered to the copper strips on the main p.c.b. via stiff copper wire "legs", ensuring that the Vero track containing the pin 9s of the i.c.s is soldered to the 0V rail, refer to Fig. 3(a). Two legs should be used for each strip—again using the minimum heat necessary.

This technique, of course, is not restricted to 1K blocks of memory, and the reader will appreciate how easy it is to extend this method to large blocks of RAM for the MPU main memory.

An excellent investment of effort is to carefully and fully clean away the solder flux from the work with cellulose thinners using a paint brush. This facilitates a check with a watchmaker's glass or magnifying lens, for solder bridges and dry joints, thus preventing flux laying across the joints, picking up moisture, and causing noise and cross-talk.

Having produced the RAM module, it is now necessary to connect buses of ribbon cable between the block and the main p.c.b. Three buses need to be connected to the RAM module: Data In (DI0 to DI7), Data Out (DO0 to DO7), and RAM Address RA0 to RA9). The p.c.b. component layout of Fig. 8 contains the above identifications (in brackets) marked against their respective vero-pin positions, and this should simplify interwiring of the RAM module and main p.c.b. Figs. 3(c) and (e) show the connections at the RAM end of the buses. Alternatively, Fig. 5 showing the RAM module circuit

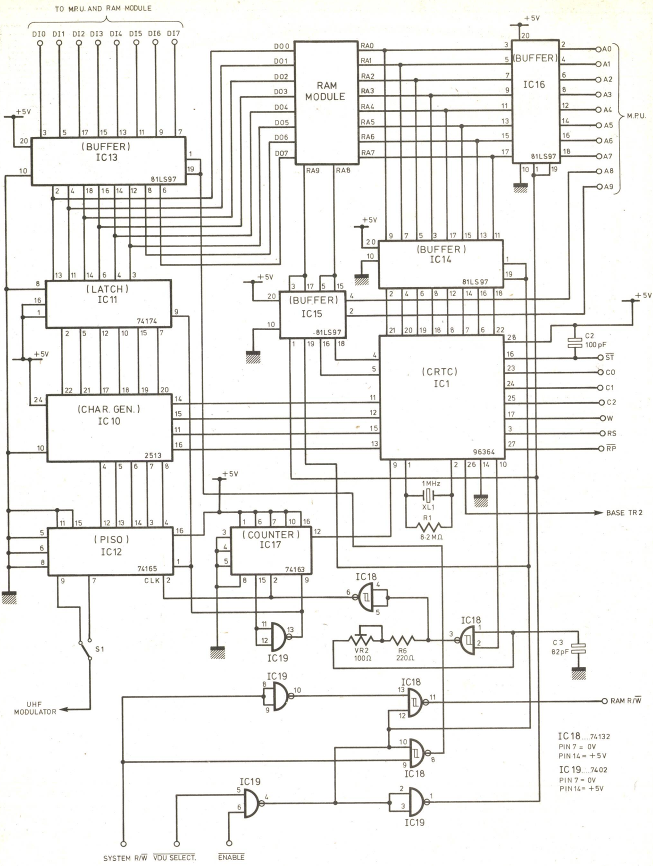


Fig. 1. Circuit diagram of VDU. (The video switching stage and stripline modulator are shown in Fig. 2)

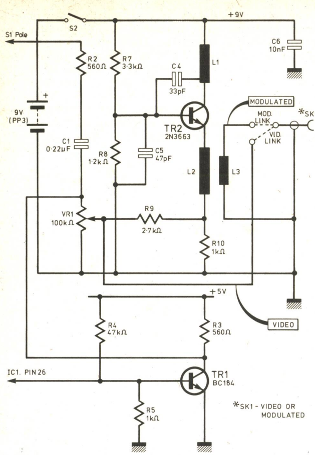


Fig. 2. UHF (stripline) modulator and video switching stage. See P.E. June 1977 for description of this modulator

diagram can be used for wiring up. It should be remembered that the RAM address lines are separate from the MPU address lines. but the Data In lines connect both to the MPU and the RAM module.

The order of connection of the data bits is irrelevent, except that data bit numbers IN must agree with bits OUT. Thus, if one of the i.c.s is chosen to accept data bit 4 IN (i.e. from the MPU bus) make sure that the same chip is chosen to supply data bit 4 OUT (to the buffer IC13).

The use of ribbon cable (preferably coloured) greatly facilitates checking faults. However, any type of thin wire is suitable, and p.t.f.e. covered wire is useful since the insulation is not prone to the usual effects of heat.

The RAM R/$\overline{\text{W}}$ line, and +5V line may now be added. Finally, connect $\overline{\text{CS}}$ (pins 13) to the OV rail. This completes the RAM module and its wiring.

MAIN BOARD ASSEMBLY

The construction of this section is conventional and straightforward. All pins for through-connections should be soldered in place first. Veropins will be found suitable. Next insert and solder all the i.c.s except for IC1 and IC10. Pay careful attention to i.c. orientation, positioning and minimum application of heat. It is better to make successive solder joints to different i.c.s, swopping back and forth between devices to expose each element to as small a temperature rise as possible. The i.c.s chosen are robust devices and, apart from IC1 and IC10, reasonably cheap, making sockets less important. However, ICs 1 and 10 should be provided with sockets. These should be soldered in next, taking care not to overheat them as the thermoplastic of which they are usually constructed melts easily at soldering temperatures.

The capacitors, resistors and transistors may now be soldered in, afterwards clipping all leads as close to the board as possible. Particular care should be taken to construct the modulator components neatly. It should be borne in mind that many of the copper foil sections on the modulator are deliberately employed as inductors. The precision of their geometry, for those who are producing their own boards, is therefore, of utmost importance.

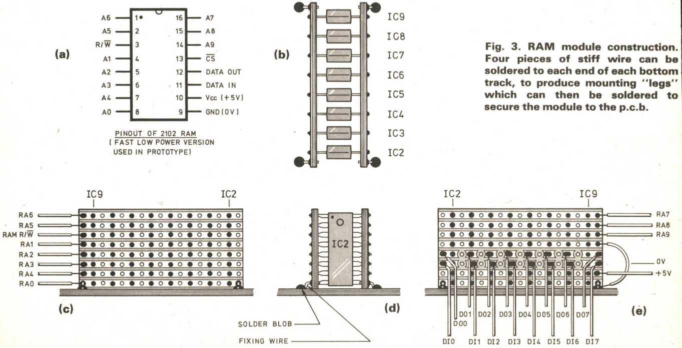


Fig. 3. RAM module construction. Four pieces of stiff wire can be soldered to each end of each bottom track, to produce mounting "legs" which can then be soldered to secure the module to the p.c.b.

The external wire links, sockets, variable resistors, PP3 battery connector (with appropriate lead length) may now all be soldered in place. The 1MHz crystal can then be inserted with a piece of insulating material between its case and the p.c.b. The crystal should be pressed up against the board and soldered, *very carefully.* A note of caution on this final component is necessary. Whether the crystal be of the wire or the pin type, excessive heat or vibrational shock will detach it from its connections within the metal case, *as the author has discovered to his cost.* Thus, once the crystal is in place, subject the board to as little physical impact as possible.

The final operation should be, as mentioned before, to fully clear the p.c.b. of flux. This is especially important around the pins of i.c.s 12, 17, 19 and associated components, and the whole of the UHF modulator section.

SETTING UP

Provision has been made on the p.c.b. for an inverting switch (S1). Initially, link $\overline{Q}$ (pin 7) output of IC12 to the centre wiper position of the switch (i.e. to R2). Q may be used later, and an external switch fitted.

IC1 and IC10 may now be inserted and, after a final check of the other i.c.s to ensure all are inserted correctly, the 5V and 0V lines may be connected to their appropriate pins on the p.c.b. A 'scope is quite useful at this point to check for the presence of a signal at the video output (collector of TR1). This should appear as in Fig. 4 when using a range of about 10µs per centimetre.

The portion A-B is a negative going TV line synchronisation pulse to ensure that the electron beam strobes across the TV screen at the right time to catch and display the video information from the VDU board. Portion B-C is at a high level to ensure that the part of the line before the character display is bright. C-D contains information controlling the line's brightness across the screen (depending upon which line of characters is being built up, and the height along these characters at which the electron beam is passing through). D-E produces the bright portion at the end of the line. Bright portions are also placed at the top and the bottom of the picture as well as between character rows. This displays the 16 lines of characters *as black upon a white background* and spaced away from the distorting edges of the screen. VR2 is used to set the length of the character rows and may be varied to suit the TV set being used.

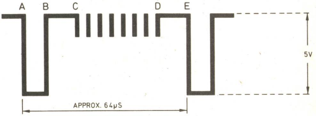


Fig. 4. Video output signal. Several of these sweeps are required to build up a line of characters on the screen, and the "light-dark" information is contained between C and D

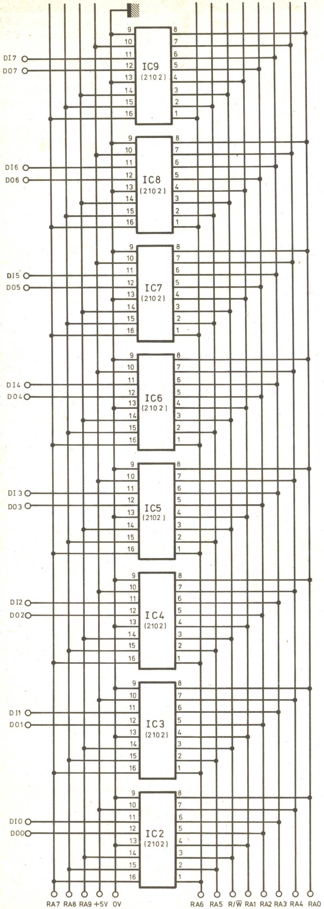


Fig. 5 (left). RAM module circuit diagram

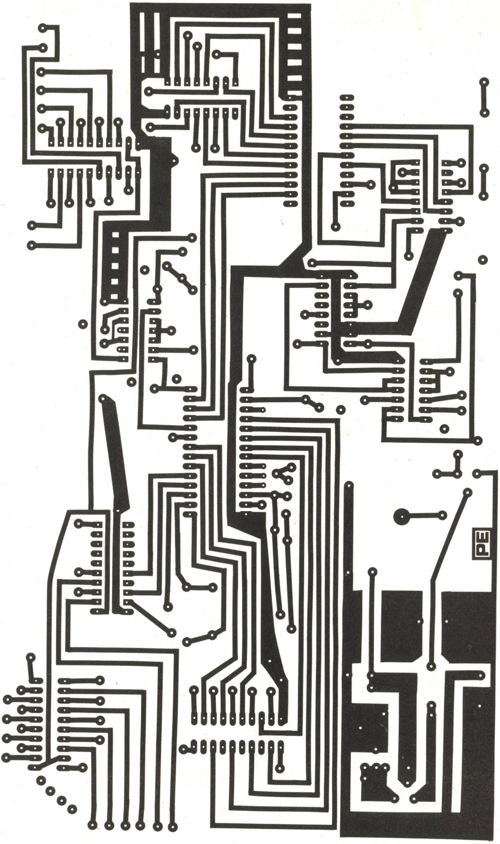


Fig. 6. Conductor side p.c.b. (Actual size). *Copyright Technomatic*

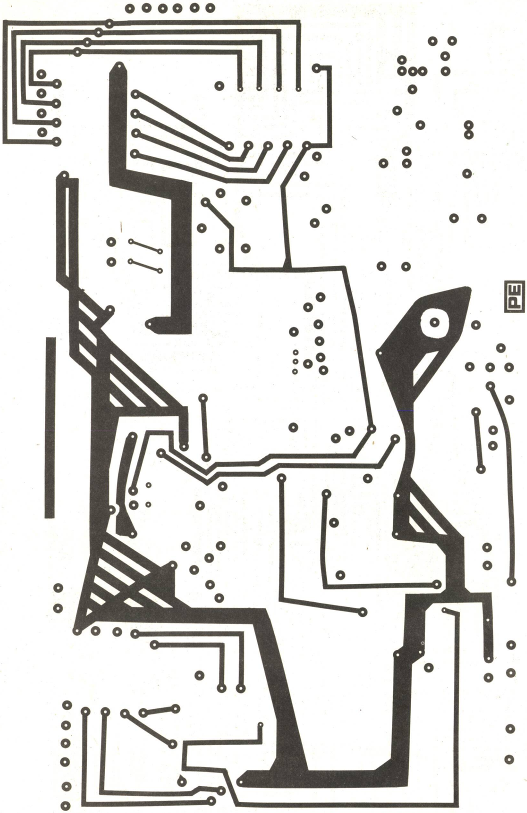


Fig. 7. Component side p.c.b. (Actual size). *Copyright Technomatic*

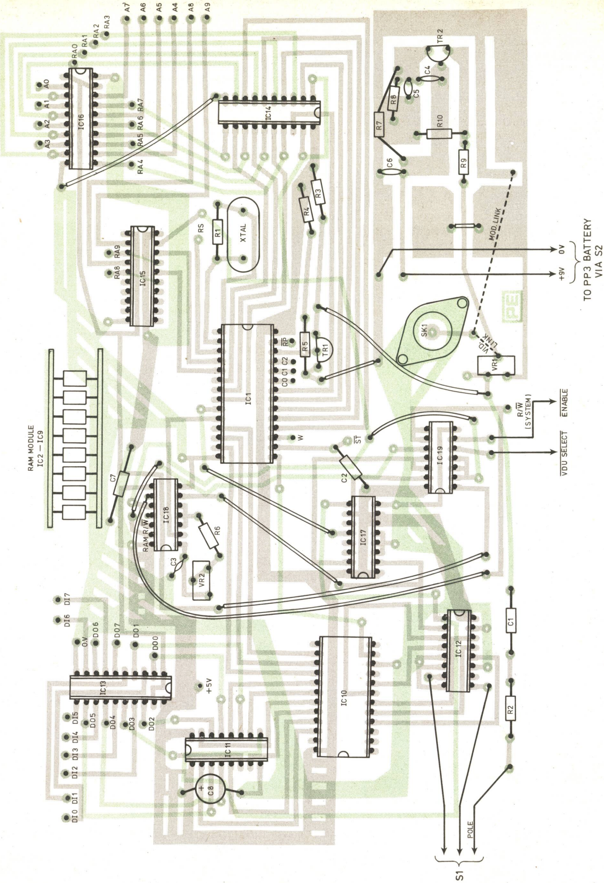


Fig. 8. Component layout for VDU board

If the correct waveform is *not* found at the collector of TR1, try looking at the ϕ_1 input to the CRTC. If no oscillation is observed, suspect IC17, IC18, the crystal, R1, R6, VR2 or C3. If 1 to 2MHz oscillations are present at ϕ_1 with a good amplitude, check that R_0, R_1, R_2, PT, address lines and sync are all oscillating. CRTC is suspect if not. If all are in working order, only IC10 and IC12 are left. R_0, R_1, R_2 and PT inputs in a state of oscillation will produce dynamic information on b_0 to b_5 outputs of IC10. LOAD and CLOCK oscillations to IC12 will produce outputs on Q and $\overline{Q}$ of IC12. By this process, the fault should be narrowed down easily.

The TTL oscillator IC18, should produce between 10 and 15MHz, which will be difficult to resolve into a sine-wave on 'scopes with a lower band-width, but the waveform ϕ_1,out of pin 12 of IC17 should be seen easily on most 'scopes.

If either a monitor or modified TV set (which can accept video directly) is available, link SK1 on the p.c.b. to the video output, and turn VR1 to minimum signal and connect up. Turn VR1 up and a display of random characters should be seen. If necessary, adjust the horizontal and frame holds. The line length can then be adjusted by VR2. VR1 should be set for the clearest display setting. The prototype gave the best picture on a modified TV by feeding the video through a very small capacitor, about 0·0001μF is adequate but some experimentation is worthwhile here.

If there is only an unmodified UHF (625 line) TV available, setting up is restricted to linking SK1 to the modulator output, plugging in the PP3 battery and tuning the set (with VR1 up full), until it receives the field and then adjusting VR1 for the best picture. Use coaxial cable with proper coaxial plugs for connections.

UHF MODULATOR

For those experiencing trouble with the modulator, the following information should be of use. The modulator has an isolated power supply which will last for some time with normal use. Check that its e.m.f. is 8 to 9 volts on load. The modulator section should not be resting on anything. Raise the whole board and support it an inch or two from the bench. The foil pattern or the value of the capacitor, C4, may be inaccurate—try replacing C4 by a trimmer and, with the TV tuned well away from any stations, tune the trimmer in to the TV.

If the TV tunes in, but the picture is unsatisfactory, even after adjustment, then the only recourse is to house the p.c.b., or at least the modulator and battery, in a properly earthed metal box (connected to the 0V line). This final construction gives very good results with the modulator if the p.c.b. is properly suspended away from the box sides (about 25mm being sufficient).

TV MODIFICATION

If you have decided to modify a TV to accept video, a few words of advice will be useful. As most sets do not have a mains isolating transformer, the first check must be to determine whether the *live side of the mains is connected to the TV's chassis.* Use an ohmmeter between mains plug and chassis. *If so reverse the live and neutral wires and use a polarised mains plug to ensure neutral remains connected to chassis.*

Somehow, the video line in the TV has to be found, broken and fed from the video output of the VDU. As mentioned before, video may be fed through a small capacitor to the TV set. The chassis of the set may also be connected through a capacitor to the 0V line of the VDU, though it was found that too small a capacitor caused an intolerable degree of mains "beating" on the display. Once again some experimentation is advantageous here.

Some sets cannot be modified as the video line is contained within an integrated circuit, and so it is as well to check this before beginning.

One final note: the constructor should appreciate that the neater the wiring, the better the display. Use coaxial cable and sockets wherever possible, especially if using UHF.

CONSTRUCTOR'S NOTE

A complete kit of parts including drilled p.c.b. is available from Technomatic Ltd. (01-452 1500) for £49 including VAT and P. & P. The p.c.b. is not plated-through as previously stated, and we apologise for this error. Constructors will find that minimal extra effort results from using the p.c.b. supplied.

A limited number of assembled and tested boards will also be available at £69 inclusive, from **Technomatic Ltd., 17 Burnley Road, London, NW10,** where a model is available for demonstration during normal hours.

Note: C9 in Part 1 components list, does not exist.

NEXT MONTH: Some ideas for interfacing to a system, some expansions of the basic VDU, and some hints on hardware for using the cursor control referred to last month.

News Briefs

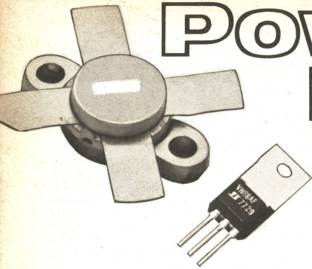
STARLIGHT VISION

A HIGH sensitivity proximity image intensifier now available from Mullard weighs less than 100 grams, and measures only 30mm in length and 43mm diameter. It is therefore particularly suitable for use in night-vision goggles and other applications where low weight and small size are of prime importance. The intensifier, type XX1410, operates from a level of illumination below starlight (10^{-4}lux), has a luminance gain of between 7500 and 15000 and incorporates automatic gain control which maintains a constant level of $3cd/m^2$ on the screen.

The XX1410 comprises a fibre-optic input window on the rear of which is deposited a low noise, high sensitivity, tri-alkali S25 photocathode (300 to 900nm). A micro-channel plate multiplies the electrons from the photocathode which are then focused onto the eye-adapted JEDEC P20 phosphor screen of a fibre-optic image inverter to form a bright image. Resolution is 25 line pairs/mm over the useful photocathode diameter of 18mm.

The intensifier is encapsulated in a white plastic body together with its own integral d.c./d.c. converter incorporating switched-mode power supply techniques. Nominal supply voltage is 2·7V d.c. and the current drain is typically 15mA.

Power FET's



A recent development in semiconductor technology

DAVID SHORTLAND

When bipolar transistors are used in high power circuits, many limitations are imposed on the designer because of inherent problems within the structure of the device. These limitations, which include thermal runaway, secondary breakdown, non-linear distortion and a limited frequency response, restrict the use of the device and have resulted in the need for complex and expensive protection circuits.

With the introduction of the Junction Field Effect Transistor (J-FET) and the Metal Oxide Semiconductor Field Effect Transistor (MOSFET) many of these limitations were overcome but the FETs themselves were limited by their poor power handling capability. Now new fabrication processes are enabling FETs suitable for high power applications to be manufactured and these power FETs will directly challenge the supremacy of the bipolar transistor in many applications.

The new processes have resulted in the manufacture of three basic devices:

The VMOS power FET
The V-JFET
The power MOSFET

The first two devices utilise vertical current flow whilst the third retains the conventional horizontal current flow normally associated with low power field effect transistors.

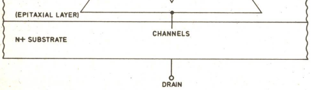


Fig. 1a. Cross section of a typical VMOS device

VMOS POWER FETs

VMOS, which is currently being developed by the Siliconix Corporation, enables a vertical channel MOSFET structure to be fabricated using a diffusion process similar to that used in the manufacture of double diffused bipolar transistors. After diffusion a "V" groove is cut into the silicon to create the vertical current channel which is a characteristic of VMOS FETs. A cross section of a typical device is shown in Fig. 1. (A double diffused bipolar transistor and a conventional MOSFET are also shown for comparison.)

The substrate of the device which is n+ material is used as the drain with the p− body separated from it by an epitaxial layer of n− material. This epitaxial layer increases the drain-source breakdown voltage by absorbing the depletion layer from the drain-body junction. Because the gate overlaps n− rather than n+ material the concentration of impurities is less, the feedback capacitance is reduced and the frequency response of the device increased. After the "V" groove has been etched through the

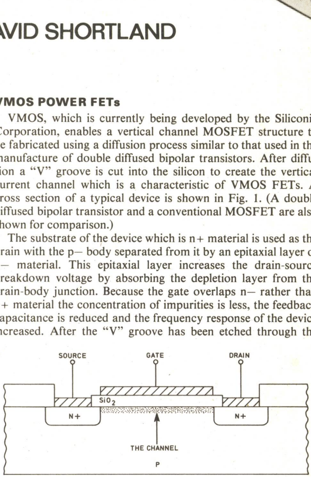


Fig. 1b. Cross section of a conventional MOS device

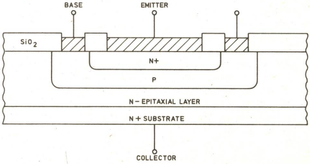


Fig. 1c. Cross section of a typical double diffused bipolar transistor

source and body into the epitaxial layer, oxide is then grown over the surface of the device and aluminium deposited to form the source and gate connections.

ADVANTAGES AND DISADVANTAGES

A comparison between VMOS and bipolar transistors includes many of the trade offs which are associated with their low signal counterparts. There are, however, several important differences which exist at higher power levels. These include:

(1) The very high input impedance of VMOS, which enables it to directly interface with other high impedance devices such as CMOS and opto-isolators. With a typical leakage current of less than 0·01mA a fanout of more than 100 can be obtained from a CMOS device which is far higher than is possible with any bipolar transistor.

(2) The absence of minority carrier storage time. This is the time taken for excess charge carriers stored in the base region of a bipolar transistor to be depleted before the junction can change from the forward to reverse bias state. This delay affects the efficiency of a circuit especially when transistors are used in switching applications, with the result that in some switching circuits faster switching transistors with a low power rating are sometimes preferred to the slower types with a high power rating. As a VMOS power FET is a majority carrier device, with its charge carriers being controlled by electric fields rather than the injection and recombination of minority carriers, the only delay is caused by parasitic elements such as series gate inductance. A typical switching delay for a VMOS device is about 4 nano seconds to turn a 1 amp current on or off which is about 10 to 200 times faster than for a bipolar device.

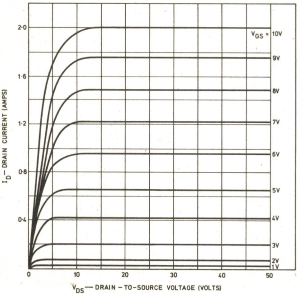


Fig. 2. Output characteristic curves of a VN66AJ VMOS device

(3) The absence of secondary breakdown. In power transistors this is caused by the very narrow base structures that are used to improve their high frequency response. The condition occurs because the distribution of current becomes non-uniform at certain high levels of current and voltage. With the current being focused on very small areas, localised thermal runaway or "hot spots" develop which melt the silicon, causing a short circuit between the collector and emitter. This problem cannot develop in a VMOS device because its temperature coefficient is negative (a bipolar's is positive). Therefore as its temperature increases it draws less current instead of more thus eliminating the device from both thermal runaway and secondary breakdown problems.

(4) The very high gain of these devices enables them to directly replace Darlington pairs with improved reliability.

The two major disadvantages of VMOS are:

(1) With VMOS technology still being relatively new there is no "p" channel device presently available for complementary circuits although one is planned for the near future. It is however possible to overcome this problem by using "n" channel devices in a quasi-complementary configuration which does not appear to impose many of the problems associated with similar bipolar designs.

(2) The saturation voltage of a VMOS device (up to 3V at 10A) is higher than for a comparable bipolar device (2V or less). This affects the efficiency of an amplifier using VMOS and as a result slightly higher power supply voltages must be used for a given power output or with the saturation region being resistive, two devices can be connected in parallel which halves saturation voltage of a single device. However, as the technology improves the saturation voltage should be substantially reduced.

There are also several advantages offered by VMOS over conventional MOS:

(1) The current density of a VMOS channel—which is determined by its width/length ratio—can be increased in a VMOS device by making the length shorter. This is because the channel length is determined by diffusion depths which can be more precisely controlled than the photolithographic techniques used to define the source-drain spacings of the horizontal MOSFET. The minimum channel length obtained in VMOS is 1·5μm while a conventional MOSFET is limited to about 5μm.

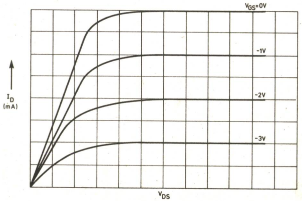


Fig. 3. Output characteristic curves of a conventional MOSFET device

(2) Because its characteristic "V" groove creates two drain channels (one on each face of the "V" groove) the current density of a VMOS device is inherently doubled.

(3) With the substrate of the device being used as the drain there is no need for drain metallisation runs on the surface of the chip. This allows the size of the chip to be further reduced and also keeps the saturation resistance low.

(4) In conventional MOS the amount by which the gate overlaps the source and drain must be large to allow for the tolerances in the photolithographic mask. This overlap increases the channel capacitance and limits the frequency response of the device, whereas the overlap in VMOS can be controlled more precisely by the diffusion techniques used.

CHARACTERISTIC CURVES

The output characteristic curves of a VN66AJ are shown in Fig. 2. If these curves are compared to those of a conventional MOSFET (shown in Fig. 3) the main difference is that the drain current is in amps rather than milliamps. The output curves are very flat because the output conductance is low, therefore any increase in the drain to source voltage, i.e. variations in the power supply voltage, will have little effect on the drain current above 10 volts due to the buffering effect of the epitaxial layer, allowing the current flow to be almost entirely controlled by the gate voltage.

HEAT DISSIPATION

Although VMOS has a negative temperature coefficient which inherently reduces the current flowing in the device as its temperature increases, it is not totally immune from thermal problems. From the graph in Fig. 4, which shows how the drain-source resistance (Rds) is affected by increases in temperature, it can be seen that as the temperature of the device rises its "on" resistance increases causing the current through the device to decrease. However, this rise in resistance causes an increase in the gate-source voltage which will increase the temperature of the device. If no action is taken to dissipate this increase in temperature the resistance of the device would not stabilise until after the safe operating temperature of the junction has been exceeded. So although the device is free from both thermal runaway and secondary breakdown problems it can still be permanently damaged by operating temperatures unless it is mounted on a suitably sized heatsink.

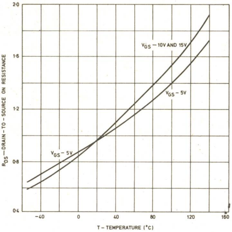


Fig. 4. Graph showing drain-source resistance against temperature (Siliconix)

SERIES AND PARALLEL CIRCUITS

The negative temperature coefficient of VMOS enables several devices to be connected in parallel to increase the current handling capacity without the need for either power wasting ballast resistors or matching networks. If one of the devices shown in the parallel arrangement of Fig. 5 starts to draw more current, its temperature increases causing the current flow to be reduced and equalised throughout the devices. When two or more VFETs are connected in parallel their total "on" resistance is lowered. This effect results in low insertion losses when VMOS is used to switch low impedance systems. If parallel devices are used in the output stage of an amplifier the lower resistance enables the same amplification to be achieved with less current being drawn from the driver stage, whereas parallel bipolar devices require current to be supplied to both bases with the result that the driver must be uprated to handle this increase in current.

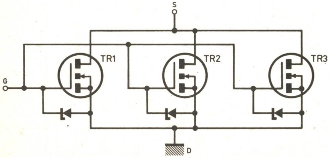


Fig. 5. Method of correcting VMOS devices in parallel (Siliconix)

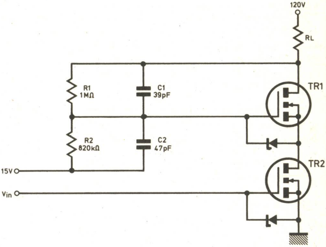


Fig. 6. Method of correcting VMOS devices in series (Siliconix)

When two or more devices are connected in series, as shown in Fig. 6, the breakdown voltage is increased. The resistors R1 and R2 have very high values because the gate drive current to TR1 is very small. To ensure a fast switching time the gate is dynamically balanced by the capacitance divider formed by C1 and C2. If the values of the resistors and capacitors are chosen correctly any number of VFETs can be connected in this way.

VMOS DEVICES

The complete range of VMOS devices available from Siliconix is shown in Table 1. They are split into three main categories: general purpose, RF and power peripheral drivers.

General Purpose N-Channel Enhancement Mode VMOS FETs

Type	Package	Power Dissipation $T_C = 25°$ C (W)	I_D (Max) (A)	V_{DSS} (Min) $I_D = 10\ \mu A$ (V)	$V_{DS(ON)}/I_D$ $V_{GS} = 10$ V (V/A)	$V_{GS(th)}$ $I_D = 1{\cdot}0$mA (V) (Min)	(Max)	t_{ON} (nsec)	t_{OFF} (nsec)
2N6656	TO-3	25	2.0	35	1.8/1.0	0.8	2.0	10.0	10.0
2N6657	TO-3	25	2.0	60	3.0/1.0	0.8	2.0	10.0	10.0
2N6658	TO-3	25	2.0	90	4.0/1.0	0.8	2.0	10.0	10.0
2N6659	TO-39	6.25	2.0	35	1.8/1.0	0.8	2.0	10.0	10.0
2N6660	TO-39	6.25	2.0	60	3.0/1.0	0.8	2.0	10.0	10.0
2N6661	TO-39	6.25	2.0	90	4.0/1.0	0.8	2.0	10.0	10.0
VN46AF	TO-202	12.5	2.0	40	3.0/1.0	0.8	2.0	10.0	10.0
VN66AF	TO-202	12.5	2.0	60	3.0/1.0	0.8	2.0	10.0	10.0
VN88AF	TO-202	12.5	2.0	80	4.0/1.0	0.8	2.0	10.0	10.0
VN84GA	TO-3	80.0	12.5	80	—	—	—	50.0	50.0

F N-Channel Enhancement Mode VMOS

Type	Package	Power Dissipation $T_C = 25°$C (W)	I_D (Max) (A)	V_{DSS} (Min) $I_D = 10\ \mu A$ (V)	$V_{DS(on)}/I_D$ $V_{GS} = 10$ V (V/A)	$V_{GS(th)}$ $I_D = 1{\cdot}0$ mA (V) (Min)	(Max)	t_{ON} (nsec)	t_{OFF} (nsec)
VN33AJ	TO-3	25	2.0	35	1.8/1.0	0.8	2.0	8	8
VN66AJ	TO-3	25	2.0	60	3.0/1.0	0.8	2.0	8	8
VN96AJ	TO-3	25	2.0	90	4.0/1.0	0.8	2.0	8	8
VN33AK	TO-39	6.25	2.0	35	1.8/1.0	0.8	2.0	8	8
VN66AK	TO-39	6.25	2.0	60	3.0/1.0	0.8	2.0	8	8
VN98AK	TO-39	6.25	2.0	90	4.0/1.0	0.8	2.0	8	8
VMP4	380 SOE-F	25	2.0	60	—	—	—	—	—

ower Peripheral Drivers

Type	Output Voltage (V)	Output Current (A)	Propagation Delay—Typical nsec	Input Voltage Logical "0" (V)	Logical "1" 10 = .30 A (V)	Power Dissipation T_c 225° C (W)	Package
S75V01	60	2.0	8.0	0.8	5.0	25	TO-3
S75V11	35	2.0	8.0	0.8	5.0	25	TO-3
S75V12	90	2.0	8.0	0.8	5.0	25	TO-3
S75V02	60	2.0	8.0	0.8	5.0	6.25	TO-39
S75V21	35	2.0	8.0	0.8	5.0	6.25	TO-39
S75V22	90	2.0	8.0	0.8	5.0	6.25	TO-39

TABLE 1

The general purpose range has ten types of VFET available in three different packages according to the power dissipation required. This range was designed primarily for amplifier and switching circuits and can be obtained in the following voltage ratings: the 2N series 35V, 60V and 90V; the VN series 40V, 60V and 80V. All the general purpose VFETs except the VN84GA include a gate to source Zener diode to protect the gate oxide from rupture due to static charge build up.

The VN84GA is a second generation device capable of handling up to 12·5A with a breakdown voltage of 80V. At low frequencies it can deliver up to 80 watts whilst at 30MHz its power output is only reduced to 50 watts.

Of the seven RF types available six are in the VN range and are used in RF power amplifiers, high current analogue and bridge switching circuits. These are available in TO3 and TO39 packages with voltage ratings of 35V, 60V and 90V. The VMP4 device, designed for VHF broad band amplifiers, receiver front ends and power oscillators, is available in the flange mounted, opposing source, strip line 380-SOE-F package.

The third category covers power peripheral drivers designed to switch reactive loads such as solenoids, relays, lamps, displays and alarms. Because VMOS devices do not have secondary breakdown problems they are particularly well suited to handling the high voltages and currents which simultaneously occur in inductive loads.

PRACTICAL CIRCUITS

In order to drive a VMOS device the supply voltage must be applied to the source and drain with the drain being positive with respect to the source. Then because it is an "n" channel enhancement type device the gate voltage must be taken positive with respect to the source and body. The electric field set up by the gate voltage induces an "n" channel on both surfaces of the body facing the gate. This induced channel enables electrons to flow from the negative source through the epitaxial layer and into the drain via the substrate. This current flow is almost entirely controlled by the gate voltage.

The simple audio power amplifier shown in Fig. 7 has an output power of 4W over a frequency range of 100Hz to 15kHz. A small signal JFET is used for the gate drive of TR2 and the design is greatly simplified by using an output transformer. The negative feedback applied via R8 keeps the overall distortion to 2 per cent at 3W.

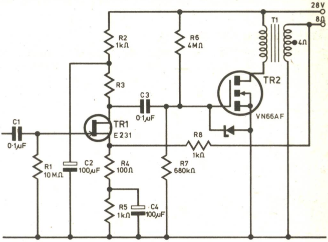


Fig. 7. Circuit diagram of a simple 4W audio power amplifier (Siliconix)

The amplifier design shown in Fig. 8 is a basic configuration using the second generation VN84GA device which is capable of handling 12·5A. It will deliver 100W into 4Ω or using 120V VNGs and raising the supply voltages to 55V. 100W into 8Ω.

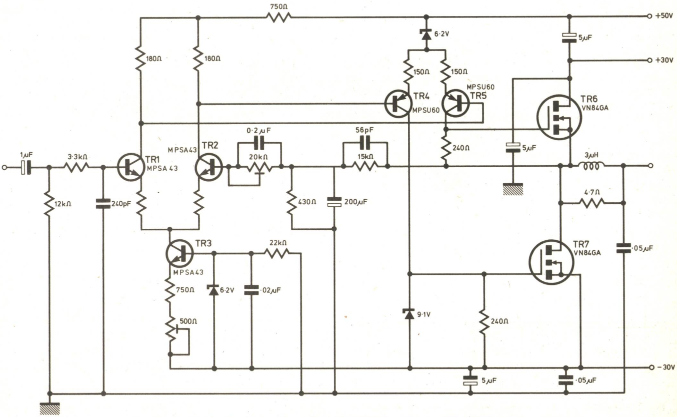


Fig. 8. Basic circuit configuration of a 100W audio amplifier (Siliconix)

THE VERTICAL JUNCTION FET (V-JFET)

The vertical junction FET, the first commercially manufactured power FET, was developed in Japan based on conventional JFET technology. Yamaha were commissioned by the Japan Development Foundation to develop a device using techniques invented by Professor Jun'ichi Nishizawa of the Electronic Telecommunications Laboratory, Tohuku University.

A cross section of a typical device is shown in Fig. 9. The body of the device which is n— material has a p+ type grid mesh diffused into it. This grid mesh structure has the effect of splitting the device into thousands of tiny FETs connected in parallel. Current flows through the channels between the gate grid and into the source. The depth of the depletion region around the gate is controlled by the gate voltage and if the depletion region is increased the current flowing through the device is reduced. Although the operation of a V-JFET is similar to that of a conventional JFET, it has many of the same advantages over the JFET that VMOS has over conventional MOS.

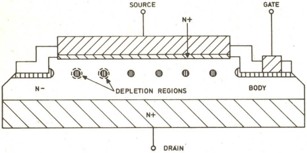


Fig. 9. Cross section of a typical V-JFET device

There are two main differences between the operation of a V-JFET and a VMOS power FET:

(1) The V-JFET is a normally on device with its maximum drain current being delivered when the gate voltage is zero. In order to bias a V-JFET off, a voltage must be applied to its gate. This effect does not cause problems at low power levels but if a V-JFET is to be used in high power applications the gate must be biased off before the supply is switched on, otherwise the drain current will rise rapidly and damage both the V-JFET and associated circuitry. On switch off the power must be removed from the output stage before the driver stage. This requirement results in a very complex power supply arrangement.

(2) Because the input capacitance of a V-JFET is higher than for a comparable VMOS device, its frequency response is lower.

V-JFET amplifiers are currently being manufactured by both Yamaha and Sony. For use in their B2 amplifier Yamaha have developed the 2SK-76 (n channel) and 2SJ-26 (p channel) power FETs which have complementary characteristics. Their respective performance figures are shown in Table 2, with their output characteristic curves shown in Fig. 10. The output power stage of the B2 is shown in Fig. 11. A higher supply voltage is used on the driver stage to ensure the FETs turn on to full conduction, and to reduce the effect of the input capacitance a symmetrical push-pull drive circuit is used. This also reduces the time taken for the gate to source input capacitance to charge or discharge and gives the largest possible high frequency response (0–100kHz). To ensure effective heat dissipation the power FETs, which are connected in parallel, are mounted on separate heatsinks by a special process which reduces the thermal resistance to less than half that achieved with conventional mica construction.

	2SK-76	2SJ-26
Drain-Gate Breakdown Voltage	200V	−150V
Gate-Source Breakdown Voltage	−40V	40V
Drain Current	10A	−10A
Gate Current	1A	−1A
Drain Dissipation	100W	100W
Max. Junction Temperature	150°C	150°C

TABLE 2

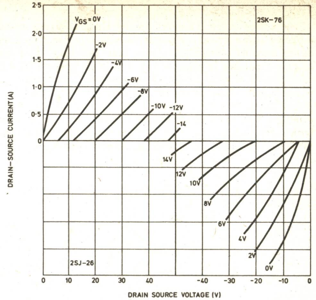


Fig. 10. Output characteristic curves of the 2SK-76 and 2SJ-26 devices

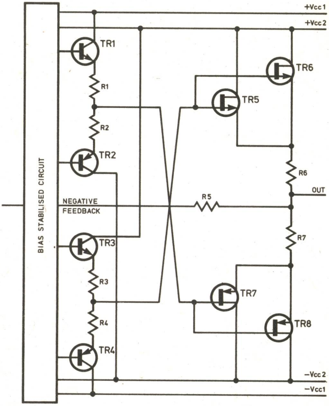


Fig. 11. Output power stage of the Yamaha B2 audio power amplifier

THE POWER MOSFET

The power MOSFET developed by Hitachi for use in their range of audio power FET amplifiers is a horizontal current device capable of handling 7 amps at 160 volts. This high current capability is achieved (as it is in all power FETs) by using a wide channel of short length which, in the case of the power MOSFET, is constructed under the gate electrode.

The power MOSFET has the same advantages over bipolar transistors that VMOS and V-JFETs have, but because it has both a high input capacitance and gate resistance, applications for the device are restricted to the audio power range.

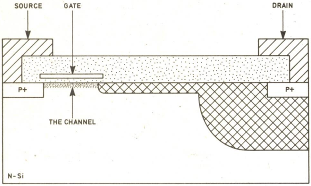


Fig. 12. Cross section of a typical power MOSFET device

A cross section of a typical MOSFET device is shown in Fig. 12. The high drain to source breakdown voltage is obtained by using an ion implanted offset gate structure. This technique, which is also used in small signal MOSFETs, reduces the electric field around the gate electrode and also helps prevent an excessive gate charge damaging the device.

	2SK135	2SJ50
Drain-Gate Breakdown Voltage	160V	−160V
Gate-Source Breakdown Voltage	14V	14V
Drain Current	7A	−7A
Gate Current	0·63A	−0·63A
Drain Dissipation	100W	100W
Max. Junction Temperature	150°C	150°C

TABLE 3

The performance figures of two complementary devices are shown in Table 3, and the graph in Fig. 13 compares the respective input powers required to drive bipolar and MOSFET devices, to achieve a 100W power output over a frequency range of 100Hz to 1MHz. With the MOSFET requiring a much smaller input power the driving circuit is greatly simplified.

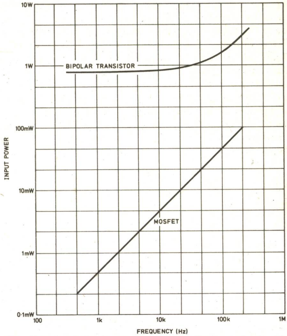


Fig. 13. Graph of the input power required to obtain 100W using MOSFET and bipolar devices (Hitachi)

The circuit diagram in Fig. 14 shows the basic design of a 100W MOSFET amplifier with parallel complementary devices in its output stage. The first two stages of the amplifier use differential pair configurations with an active collector load in the second stage to provide the push-pull action. The coil in the output line reduces the residual distortion which is induced by magnetic coupling between the output line and power supply wiring, from 0·01 per cent to 0·003 per cent. The total harmonic distortion at 100W is about 0·01 per cent, which is about ten times better than ordinary bipolar amplifiers. ★

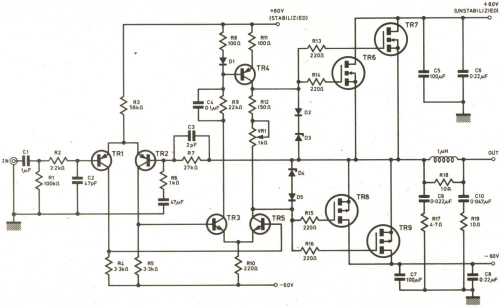
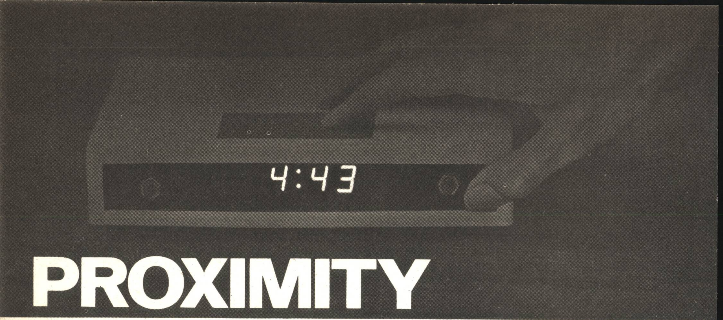


Fig. 14. Basic circuit configuration of a 100W MOSFET amplifier (Hitachi)



PROXIMITY SWITCH

A.K. LANGFORD

THE touch switch described here evolved from a need for a switching method that would activate the display of a digital clock for a short viewing period, the display being normally off.

To do this without modifying the fascia of the clock suggested the use of a proximity type sensing plate mounted inside the plastic top cover, so that touching the top cover would operate the time display. The system devised was found to be sensitive, and could be suitable for many similar applications.

CIRCUIT OPERATION

No originality can be claimed for this type of circuit, although systems of this type usually operate directly from the 240V mains. However, it was found that by incorporating a gain adjustment, adequate sensitivity was obtained from low voltages in the range 12–25V a.c. The principle of operation of the switch can be explained by considering the input to gate 1. This gate is biased into conduction by the 1MΩ resistor, and the voltage at the input settles to about midway between V_{DD} and V_{SS}; but by virtue of the single wave rectification of D4 from the secondary winding of the power transformer, the amplifier gate input is swept from approximately $V_{DD}/2$ to peak a.c. volts—$V_{DD}/2$ at 50Hz. Consequently when the plate is touched the input is referenced to zero volts by hand capacitance, and an a.c. voltage appears at the input to gate 1. Negative a.c. feedback via R1 and C1 reduces the sensitivity of the amplifier to stray high

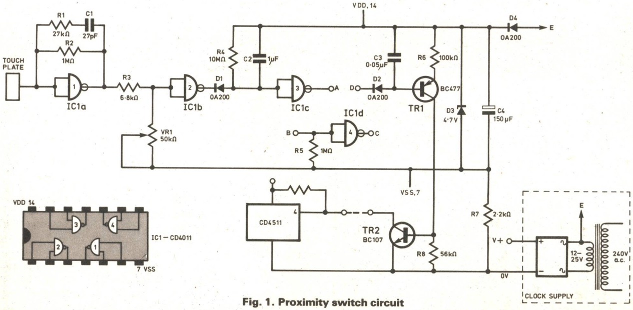


Fig. 1. Proximity switch circuit

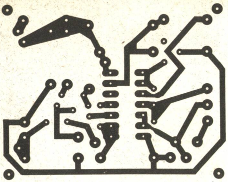


Fig. 2. P.c.b. layout

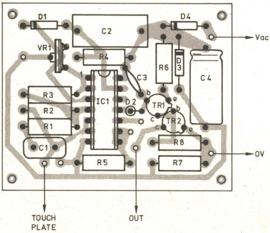


Fig. 3. Component layout

COMPONENTS . . .

Resistors

R1	27kΩ
R2	1MΩ
R3	6·8kΩ
R4	10MΩ
R5	1MΩ
R6	100k
R7	2·2kΩ
R8	56kΩ

All ½W carbon 10%

Potentiometer

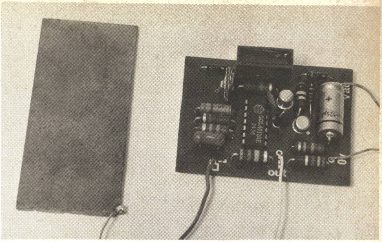
VR1	50kΩ preset

Capacitors

C1	27pF
C2	1µF
C3	0·05µF
C4	150µF elect. 40V

Semiconductors

TR1	BC477
TR2	BC107
IC1	CD4011
D1–D2	OA200 (2 off)
D3	4·7V Zener 400mW (BZY88C)
D4	OA200



frequency pickup by the plate.

The amplified 50Hz signal is fed to the second gate which has its input switching threshold set by VR1, serving as a sensitivity control. The setting of this level is stabilised by the output voltage of gate 1 being used as the reference. By the action of R2, this is the characteristic switching voltage for the i.c.

Gate 2 shapes the signal and this charges C2 through D1, thus switching gate 3. The R4/C2 time constant determines the period for which the display is on. With the values shown this is about five seconds.

The output from gate 3 is not suitable for driving logic circuitry working from the zero volt supply. Therefore TR1, TR2 are used as level shifters, with TR1 acting as an inverting current switch driving TR2.

This was used to operate the blanking input to a CD4511 decoder/latch/driver. This input was held high to inhibit the display, with operation of the proximity switch causing TR2 to turn on and so allow the time to be seen.

For other applications it may be that reverse operation of TR2 is required (i.e. TR2 normally on, and is turned off by touching) and for this purpose gate 4 is available to invert the output from gate 3. If this is the case the connection A–D is removed and connections A–B, C–D substituted.

CONSTRUCTION

A printed circuit layout is shown in Fig. 2. Extra holes are not shown for optional mounting of a horizontal preset resistor for VR1. Here the choice will depend on the mounted position of the board so that there is easy access to adjust for sensitivity.

Further holes are present to allow for the addition of the inverting gate 4, if this is required. Alternatively the printed circuit could be modified to include this gate.

The sensing plate may be a piece of aluminium foil or copper laminate glued inside the plastic or wooden case of the switched equipment, and is connected by a short length of wire (less than 12in) to the component board.

ADJUSTMENT

The size of the sensing plate is not critical and a 5cm square worked well on both 12 and 25V a.c.

The sensitivity control should be finally adjusted when the plate and switch board are mounted in their permanent positions. If the zero volt line is "mains earthed" then there will be a change in sensitivity, but this is easily compensated for by adjustment of VR1. The sensitivity can be adjusted to trip at a distance of several inches, or by lightly touching the case—depending on individual preference. ★

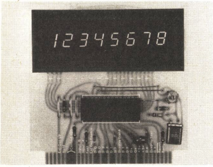
Market Place

Items mentioned are usually available from electronic equipment and component retailers. However, where a full address is given, general enquiries may be made direct to the firm concerned. All quoted prices are correct at time of going to press.

by Alan Turpin and David Shortland

8-DIGIT COUNTER-TIMER

The 8-digit counter/timer introduced by Lascar Electronics is claimed to perform all the major counting and timing functions. The module can measure frequency from 0–10MHz, period from 0·5 micro-seconds to 10 seconds, frequency ratio between two inputs, time intervals in increments of 0·1 micro-seconds, and can also function as a normal 8-digit totaliser. Mode selection is by a single external switch.



Four different ranges can be selected which determine the time or the number of cycles that the displayed data is accumulated over.

Fitted with 0·4in, high efficiency orange l.e.d.s, the modules operate from +5V d.c. Controls include store, hold and reset, while various outputs enable all functions to be monitored externally. The module is fitted with a 10MHz quartz crystal to give a highly accurate timebase, with a temperature stability of ±10ppm over a temp range −20°C to +70°C. Price is £54·95 plus VAT.

For further information contact **Lascar Electronics Limited, P.O. Box 12, Module House, Billericay, Essex.**

ALL THAT GLITTERS

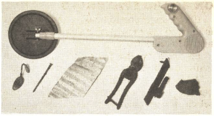
Autumn is here and the beauties on the beach are covering up, so take a last look at this delectable detector by courtesy of Dixons publicity department.

Dixons offer four versions; one for children and beginners at £29·95, two sophisticated models at £39·95 and £49·95, and an enthusiasts machine with meter, at £69·95, which Dixons claim can detect a single coin at one foot, or larger objects at four feet.

ANY OLD IRON/ALLOY/CARBON

Rumour has it that there is five hundred million pounds of lost or buried treasure in the country.

Market Place has been trying out an induction balance detector over lawns, paths, flower beds, etc. We didn't find any valuables but did dig up one of Uri Geller's old spoons, a six inch nail, aluminium lawn edging, a pair of rusted secateurs, a large garage door hinge pin, and a piece of coke.

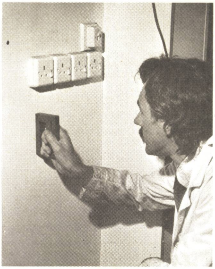


At only £13, inc. p&p, you might well uncover the cost of your investment.

Readers P.C.B. Services Limited, P.O. Box 11, Worksop, Notts.

HANDY DETECTOR

Pocket size detectors which can trace wiring or water pipes and show the presence of iron reinforcing are available from sole U.K. distributors HDP Electronics Ltd.



There are three models: a metal detector (403), a voltage indicator (405), and a combination unit (407).

The detectors run off one 9V battery and indication is by a signal lamp.

Volltronic is the name of the range which is manufactured in West Germany.

403 and 405 are £13·19 and the 407 is £28·64, including p&p and VAT. Trade enquiries invited.

HPD Electronics Limited, 34/38 Dock Street, Leeds LS10 1JF. Telephone 450222.

6800 PROGRAMS

JCN Electronics have four programs for 6800 based microprocessors. They have been written to run with MIKBUS firmware and are available as photocopy listings or all together on a Cuts Format Cassette at £2 inc.

Lunar Landing	75p
Mastermind	30p
Matchsticks	30p
Print Formatter	20p

Send large s.a.e. to **JCN Electronics, Hodsock Park, Langold, Worksop, Notts. S81 0TF. Telephone Worksop 730282.**

Note. October Market Place, Wonderboards. Orders should include 30p for p&p.

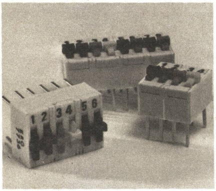
ON BOARD SWITCHING

If you are prone to housing small projects in tobacco tins these dual in line switches may help the aesthetics.

Fit them on the track side of 0·1 inch matrix board, then stand the board off the lid.

As well as smarten up a front panel they can be used, on board, as function/mode selectors, test switching, range changing, etc.

Contact ratings: 1μV to 100V a.c., 1μA to 1A—at up to 10VA.

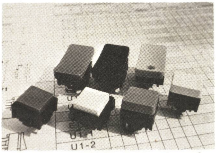


They are colour coded as per the resistor colour code and are available in banks of 4, 6 and 8 at 84p, £1·24 and £1·52 each, including p & p but add VAT at eight per cent.

Verospeed, Barton Park Industrial Estate, Eastleigh, Hants SO5 5RR. Telephone: 0703 618525/6.

MINIATURE PUSH BUTTON SWITCHES

A range of miniature snap-action push button switches, designed for 0·1in printed circuit board mounting is now available from Impectron Ltd.



They have a positive snap or rocker action. Single pole press-to-break and changeover configurations are all available as standard, and an l.e.d. indicator can be incorporated to provide visual warning of function selected.

The basic body size of all types is 12·4 × 12·4 × 7·5mm. The selected push button or rocker action will add a further 5mm to body depth.

Switches may also be mounted in line or block format to form key sets with mechanical interlocking and release mechanisms.

Despite their small size the switches are capable of handling up to 25mA at 50V d.c. Contact resistance is less than 20mΩ and operational life is in the excess of 10^5 operations at full load. Operating temperature range is −25° to +75°C.

Impectron Limited, Impectron House, 23–31 King Street, London W3 9LH. Telephone 01-992 5388.

"I AM YOUR AUTOMATIC MUSIC CENTRE"

Sharp's SG500 has front located controls so that there is no need to lift the dust cover to operate. It has a LW/MW/SW/FM/FM MPX stereo tuner amplifier, a two motor drive cassette deck and a direct drive record player.

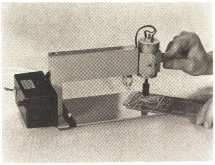
The amplifier has a 45W/channel (r.m.s.) output with 0·5 per cent THD at 4Ω and sensor touch tuning on FM with up to seven preset stations.

Sharp's Auto Programme Search System is included in the cassette section, which locates and plays back automatically the track required, as well as Dolby noise reduction and tape selectors and changeover facilities.

The sensor touch player has a 31cm turntable and a VM type cartridge. An auto disc detection system determines whether there is a record on the turntable and also its size, so that it automatically plays at the right speed and leads the arm to the correct position. Price is £644·95. Remote control accessory, £84·95.

LARGE THROAT P.C.B. DRILL

A p.c.b. drill stand, specially designed for drilling small quantities of boards, prototypes, one-off production specials, missed production holes and modifications, is now available from Technomark, Maidstone, Kent.



The motor body is supported on a cantilever spring system which switches the motor on when depressed. If the motor body is adjusted so that the motor switches on with the drill just touching the board surface, drill wander can be eliminated to enable accurate drilling of plain copper surfaces.

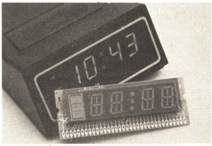
It has an integral 12V d.c. power supply, fused and switched, low voltage lighting and a reliable high speed motor. Throat depth is 168mm.

Each unit comes complete with chuck, collets, light and x-y locating jigs. Price is £61 plus VAT.

Technomark, Allnut Mill, Church Road, Lower Tovil, Maidstone, Kent.

CLOCK DISPLAY

A four-digit, seven-segment light-emitting-diode display designed for digital-clock applications has been introduced by Micro Electronics Ltd. The MCD 461 Series has a red numeric display which uses 0·6in (15mm) high gallium arsenide phosphide light-emitting diodes. Both 12 and 24 hour versions are available.



The display is designed to offer a wide viewing angle, and can be mounted with a 0·1 in-pitch edge connector or connection pins.

The static forward voltage per segment is 1·7V and the maximum ratings at 25°C are: reverse voltage 5V; peak forward current per segment 200mA; continuous forward current per segment 20mA; and power dissipation 300mW. Operating temperature range is −20°C to +75°C.

The price of the unit is £54·95 plus VAT and for further information contact **Micro Electronics Limited, York House, Empire Way, Wembley, Middlesex.**

Market Place

REVIEW OF INTRUDER ALARMS AND SECURITY SYSTEMS

Beat the burglar if you can. He'll be straight in through everyday doors and windows. Mortice locks will make him think twice, but until we have shuttered windows like our EEC neighbours then a piece of treacled paper is all he needs for a silent entry—unless you detect him and sound the alarm. Vandalism of private property is on the increase too. Big dogs are expensive to feed so how about this doppler fido.

ELECTRONIC WATCHDOG

The BD 100 is a security device which combines the function of electronic clock with an intruder alarm. Unobtrusively built into a digital clock, the burglar alarm is brought into readiness by removal of an electronic 'key'. This sets up transmission of an inaudible high-frequency signal which establishes a sensitive field completely filling the room in which the alarm is set. Disturbance of the field by an intruder or any movement in the room is registered by the unit, setting off a high intensity audible alarm similar to that of a motor car horn. The alarm signal may be silenced only by the insertion of a uniquely-matched electronic key.

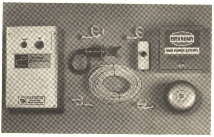
The device allows a 20-second delay between entry into the room and insertion of the key without setting off the alarm. A similar delay allows removal of the key on departure.

Unlike many burglar alarm systems designed for the home, the BD 100 requires no special wiring. The unit simply plugs into a standard 13-amp mains socket. If there is a power cut, or if the plug is removed from the socket, internal batteries take over the power supply. The batteries are recharged when mains power is resumed.

The price of the BD 100 is £62·00 plus VAT and further information can be obtained from **Fotherby, Willis Electronics Ltd, Gladstone Terrace, Stanningley, Leeds.**

ALARM KIT

The "Remick" burglar alarm kit, complete with instructions and wiring diagram enables a handyman to install the system to suit his own requirements. The kit—which includes a control unit, four sets of magnetic switches (for doors or windows), pressure pad (for front door mat), mini siren and cable—can be extended to suit any size premises by fitting additional sensors and alarms which can be obtained separately.

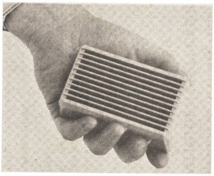


The system operates from mains supply with the loop circuits and alarm bell at 12V d.c. The double loop circuit is provided so that any attempt to cut or short the leads will result in the alarm operating. Whenever the alarm rings it continues until it is manually switched off by the keyholder. A 12V battery is supplied to maintain the operation of the system during a mains failure.

The price of the kit is £56 plus VAT. For further information contact **Photain Controls, Unit 18, Hangar No. 3, The Aerodrome, Ford, Sussex.**

MINI-MICRO

The ML-1500, which is also available from Photain Controls, is a miniature doppler microwave detector which has a linear range of 15 metres with a wide 140 degrees horizontal beam pattern. A special protection circuit prevents any interference from fluorescent lights affecting the circuit.



The unit should be mounted 2–3 metres above floor level and as microwaves can penetrate certain building materials such as glass and thin partitions, the unit should be pointed away from windows wherever possible. Price £80 plus VAT.

TOUCHLESS CONTROL

The door control system marketed by Inertial Systems is virtually vandalproof because the sensor and control equipment are concealed in the wall near the door and operated by presenting a "command key", rather like a credit card, a few inches away from the sensor. Once the validity of the card is established the control unit operates the electronic lock on the door.

The command keys are precision tuned passive circuits which when energised by the sensor return a specific frequency pattern. The keys can be programmed with individual private codes to enable the system to grant or deny individual access according to the time and day. If required, the system can maintain a printed record of individual entries and exits by the time and date.

For further information contact **Inertial Systems Limited, Elvaco House, High Street, Egham, Surrey.**

SELF TEST SYSTEM

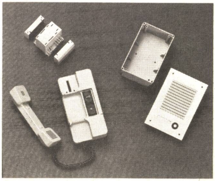
The Mk III Harley alarm system has a self test facility which checks the unit when it is switched on. The complete system includes a 12V battery, key bypass switch, battery level indicator, a "bell test" circuit, five magnetic contacts for doors or windows and two anti-tamper micro switches, one of which will operate the alarm whether or not the unit is on or off if any attempt is made to interfere with the control unit.

For further information contact **Harley Security Systems, 94 Normandy Street, Alton, Hants.**

DOOR ANSWERING SYSTEM

The Siedle 2000 door communication system available from Baron Security is a D.I.Y. unit suitable for use in individual homes.

The system consists of a door loudspeaker/microphone, home telephone, bell transformer and door release mechanism. The front plate of the door loudspeaker unit is flush mounted and includes a call button in the name plate.



The entrance door latch can be released by pressing the button mounted on the telephone.

The recommended price of the Siedle 2000 is £76·15 plus VAT and it is available from **Baron Security, 52 Monmouth Street, London.**

Car Devices

Here is a collection of simple projects for use in vehicles with 12V systems

AUTO-LIGHT

P. Scargill

THE circuit to be described will be especially useful to those motorists who have been in the unfortunate situation of being left with a flat battery through leaving their lights on all day, or worse still, those who have been stopped at night by the police for having no lights on, as it will automatically switch both side and dipped lights on when the ambient light level warrants such action.

It is left unaffected by short tunnels, street lights, etc. so that before long the user will wonder why all cars don't have such a device.

Construction should present no problems, and as an added bonus, the front panel has a couple of indicators so that you can amaze non-technical friends with the wonders of modern science. These also function as lighting status indicators so that if you should ever have cause to use the car lighting on manual, they will act as a handy switch off reminder. By the use of moderately rated components, it is most likely that the life of the unit will outlast that of the vehicle.

CIRCUIT

The operation of the circuit is shown in block form in Fig. 1. The ambient light level present at any one time is sensed by a photocell and the output of this is compared to a fixed reference. When the light level falls, a timing circuit is started up. The instantaneous light level is hence averaged out over a period of time.

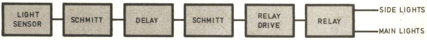


Fig. 1. Block diagram

The output from this section is again compared to a fixed reference and when a certain level is exceeded, the resulting output is fed to a relay which controls the car lighting.

Fig. 2 shows the basic diagram of a Schmitt of the type used in this circuit.

R_a and R_b hold the op amp + input at a level of around half the supply voltage. Hence if V_{in} exceeds +V/2, the output will swing low. R_c introduces positive feedback to the circuit which as well as ensuring sharp switching of the output, introduces a certain amount of hysteresis which is determined by the combination of the relative values of R_a, R_b and R_c.

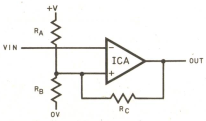


Fig. 2. Schmitt circuit

The format used in Fig. 1 ensures that there is no loading of the input by the presence of R_c.

In referring to Fig. 3—R1, VR1, and R11 form a resistive voltage divider across the supply rails, the voltage at the junction of R11 and VR1 varying in accordance with changes in ambient light level.

This voltage is fed via R2 to IC1, a Schmitt as described previously, so that the output of IC1 changes state at two different light levels, an upper and lower level brought about by the hysteresis produced by the presence of R5.

So we have a simple light sensor, but one incapable of distinguishing between light-up time and, say, a short dark tunnel.

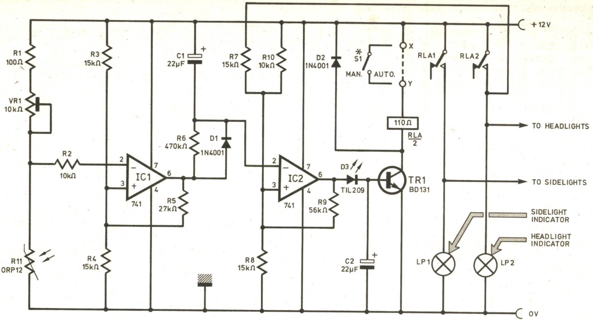


Fig. 3. Circuit of Auto-Light

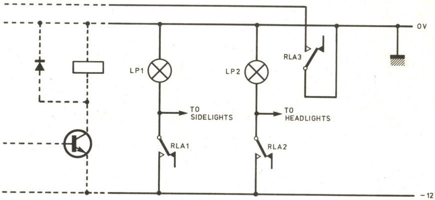


Fig. 4 (below). Modification for positive earth

The following stages are therefore essential for correct operation of the circuit for the application with which we are concerned.

Components R6 and C1 form a charging circuit which produces a 20 second delay in conjunction with IC2. C1 has been taken to +V so that at switch-on, it will be discharged and will hold IC2 input high, keeping the output low.

If the situation was reversed and C1 was returned to 0V, when the ignition was switched on, there would be a momentary flicker of the lights in daylight. This could be put to good use if a momentary delay was introduced to the output to combat this pulse, as a delay defeat would be realised at ignition switch-on.

However, for the sake of reliability and simplicity this feature has been omitted from the present circuit.

D1 ensures that the delay is not cumulative—a succession of short tunnels will not trigger the relay.

In this situation without D1, the motorist would find his lights triggering prematurely which, to say the least, might annoy other motorists.

TR1 is the relay driver, with C2 preventing any supply generated pulses from reaching the relay.

D3 is not used as an indicator (although there is no reason why it should not be brought out to the front panel if desired) but is used as a form of Zener to ensure that TR1 receives no input when IC2 output is low.

Feedback is applied from the relay back to IC2 pin 3 to ensure that any battery voltage changes do not cause relay chatter. Normally this would not occur but it has been found that in freak conditions this can occur if R7 is not present. It is essential to prevent relay chatter in this application in order to prolong the life of the relay contacts.

In this circuit, use is made of the output current limiting of the 741 op amp in restricting the current to D3, therefore it is not recommended to use any other type of op amp. However, most *npn* power transistors are suitable for TR1 and the relay is not critical provided it has a 12V coil and that the contacts are capable of handling the current.

CONSTRUCTION

Construction and layout are not critical as there are no particularly sensitive sections in the unit. However, good soldering is essential in any gadget for use in a vehicle because of vibration effects.

In the prototype, a copper-clad etched circuit board was used, details of which are given in Figs. 5 and 6.

A relay with 5 amp contacts was used in this prototype as the headlights in many modern cars have their own relay drive. If the unit is to be used in a vehicle without this facility (particularly if extra lights have been fitted) a relay with 10A contacts may be better.

Tandy sell a very nice enclosed relay with DPCO contacts with this rating. However, a bigger case will be required than that shown unless the relay is housed separately to the main unit.

FITTING AND SETTING UP

The unit should be mounted as near to the lights switch as possible. From that switch it will be possible to obtain tappings into dipped lights, side lights and in some cases a live switched through the ignition. An earth will have to be found elsewhere.

Finding out which wire is which on the car lights switch is a matter of consulting the vehicle wiring diagram and no advice can be given as all cars are different in this respect.

The sensor should not be mounted in a position where it is in direct line with any strong source of artificially generated light, i.e. opposing traffic headlights, although the unit is not particularly sensitive to this light. The best place to mount it is in the left hand corner of the dash, preferably out of sight. Positioning is not critical, however.

Having wired the unit up, it is simply a matter of waiting till lighting up time for final adjustment of VR1. A voltmeter across 0V and IC1 output will give an

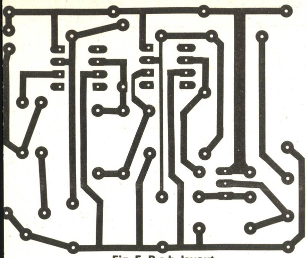


Fig. 5. P.c.b. layout

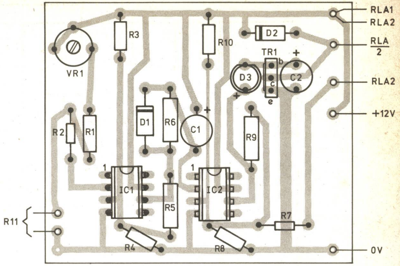


Fig. 6. Component layout

instantaneous indication of triggering rather than having to wait out the delay after every small adjustment.

Adjust VR1 until the exact point at which IC1 output goes low is found and leave the preset at this exact point. Now fasten the case up and that is all there is to it.

The car lights should now come on after about 20 seconds, and should go off immediately the ignition is switched off. On turning the ignition back on, there should be a further 20 second delay before the lights come back on. Check to make sure the correct lights are operating and also that both of the indicators on the unit itself are working correctly. If the auto/manual switch is fitted, switch to manual, put side lights on manually in the normal way, and make sure the correct indicator shows on the unit.

COMPONENTS . . .

Resistors	
R1	100Ω
R2	10kΩ
R3	15kΩ
R4	15kΩ
R5	27kΩ
R6	470kΩ
R7	15kΩ
R8	15kΩ
R9	56kΩ
R10	10kΩ
R11	ORP12
All resistors $\frac{1}{8}$ watt 5% carbon.	
Potentiometer	
VR1	10kΩ preset

Capacitors	
C1, C2	22μF elect 16V (2 off)
Semiconductors	
D1	1N4001
D2	1N4001
TR1	BD131
IC1, IC2	741 (2 off)
D3	TIL209
Relay	
RLA	12V d.c. 110Ω coil two-pole changeover (R.S Cat. No. 348–835).
Miscellaneous	
S1*	S.p.s.t. miniature on/off (if required)
LP1-LP2	12V indicator lamps

VARI-WIPE

B. A. Bell

An intermittent wiper control facility is now standard equipment of many new cars. Such a unit proves indispensible in British weather, and the present design allows a wiper delay to be added to any car. It is of very simple design, making it easy to build successfully. The small number of components make the unit reliable, and keeps the cost below that of four gallons of petrol.

CIRCUIT DESCRIPTION

The circuit is shown controlling a two-speed wiper motor with a motor-shorting parking switch; this represents the arrangement on most recent cars. The simpler circuit used on older cars, with a non-shorting parking switch, will also work with this design.

In normal operation of the wipers, with the unit turned off by S1, RLA/1 restores the original connection which is broken on installation. When the wiper switch is moved to "Slow" or "Fast", the appropriate winding on the motor is disconnected from the limit switch and connected to the 12 volt supply, the motor running continuously. On switching the wipers off, the motor is connected to the limit switch which maintains the 12 volt supply until the park position of the wipers is reached. The limit switch then disconnects the 12 volt supply and short circuits the motor, providing rapid braking.

If the intermittent control is now switched on with S1, C2 begins to charge at a rate determined by R2 and VR1. When the voltage across C2 exceeds the Zener voltage of D1, the Zener diode conducts and switches TR1 on. RLA/1 operates and connects the 12 volt supply to the motor "slow" winding via the wiper switch. As the motor runs, the limit switch moves to the "Run" position to maintain the motor supply, and also short circuits the intermittent control unit, discharging C2 via D2 and S1, and resetting the circuit completely. At the completion of one sweep of the wipers, the limit switch parks the motor and removes the short circuit across the intermittent control, restarting the cycle.

The repetition rate of the cycle depends on the setting of VR1, and the values given in the circuit provide a delay adjustable between five and 30 seconds. R2 may be decreased in value if a shorter sweep delay should be required. R1 limits the base current in TR1 when D1 conducts, and C1 charges rapidly when RLA/1 operates to hold the relay closed until the limit switch takes over the supply to the motor.

CONSTRUCTION

The components making up the circuit can be conveniently housed in a small plastics box.

The box may be mounted underneath the dashboard or may be mounted remotely, with VR1 connected by flying leads. Only three connections are required to the vehicle, a 12 volt supply from the ignition switch, and an interruption in the wire which connects the wiper switch to the motor.

This connection can be made by unplugging this wire from the switch behind the dashboard, and connecting the unit to the now vacant terminal on the switch and to the free end of the unplugged wire. If the unit is removed from the car at a future date, this wire must be replaced.

COMPONENTS . . .

Resistors
R1 39Ω
R2 1kΩ
All ¼ watt 10% carbon

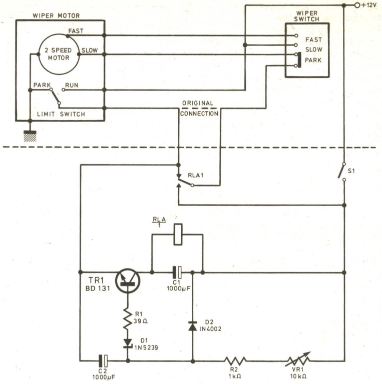
Potentiometer
VR1 10kΩ

Capacitors
C1 1,000µF elect 15V
C2 1,000µF elect 15V

Semiconductors
D1 1N5239
D3 1N4002
TR1 BD131

Relay
RLA KMK1/12DC Keyswitch

Miscellaneous
Plastics box 5in x 2in x 2in with lid
S1 on/off switch



Vari-Wipe circuit

IN USE

The unit is operated by rotating VR1 and setting the desired delay. If there is a temporary increase in spray or rainfall, the intermittent action is over-ridden by operating the wiper switch in the normal way. This automatically disconnects the unit until the wiper switch is turned off, when the intermittent action will be resumed. The prototype has functioned faultlessly for two years on a number of cars, and worked first-time when it was assembled.

ASSISTED IGNITION SYSTEM

G. C. Wride

BACK in the early 1900's a man invented an ignition system comprising of two coils of copper wire, one with a large number of turns, the secondary, and the other a few turns, the primary; he then connected the primary across the battery via a pair of contact breakers across which he connected a condenser. This is the Kettering system which has changed very little since then with the exception of improved materials. Well, way back in 1905 I doubt if they had an engine which would rev much over 2,500 r.p.m. so the system worked very adequately, but most cars these days can rev to at least 5,500 and quite a few to 7,000 and the Kettering system starts to have a hard time keeping up.

Let's look at the low rev end first, for instance, tick over—the points are opening slowly, this gives some of the stored energy in the coil time to arc across the gap so not only burning the points but losing valuable output to the plugs. At the mid range, say, between 2,000 to 4,000, things are not so bad, the output rising to about the maximum to be expected. Things start to go wrong at about 5,000 and above as the available time for the coil to recharge itself is very short (coil recovery time).

Points may bounce, further reducing coil current, and to make matters even worse, because of high cam speed the points tend to close late and the net result of all this is very low output to the plugs.

Finally, after 5,000 miles, the points are so burned that they have to be thrown away and the timing re-done.

SYSTEMS COMPARED

Now we've looked at the problems, let's see how we can get over them. About 10 years ago the "Capacitive Discharge System" arrived on the scene; this was really excellent but in the early days it suffered from s.c.r. "hang-up's" or "latch on's", also the discharge capacitor was somewhat unreliable.

It operated by inverting the 12 volt supply up to 350 volt with a pair of 2N3055s, charging a capacitor then dumping the lot across the coil via the s.c.r. which was triggered by the points.

Its counterpart the "Points Assisted System" basically replaces the points with a power transistor capable of withstanding 300–400 volts or so, which is a very good move since the transistor in this position is a far better switch; secondly, point burn is eradicated, other than this, unfortunately, the system mimics the points exactly. Taking a long look at the aforementioned system I decided there were a number of improvements that could be made.

The ignition coil is basically efficient, its losses mainly being due to its own internal resistance, which we can't do anything about and the external components, which we can. Firstly, we replace the points with a transistor, preferably the type specially designed for switching; secondly we can "tune" the coil to the engine's requirements, these being:

(a) A fast rising waveform
(b) Large amplitude
(c) A slow decay

Unfortunately, none of these conditions are complementary so a compromise must be found.

This design ensures that the maximum possible current for the longest possible time flows in the primary of the ignition coil, this being determined very simply by the use of a monostable; the only work that the contact breaker does is to trigger the monostable via a differentiator so their life is only determined by mechanical wear.

By careful differentiator design it was possible to build in three other innovations, these being:

(a) Contact bounce suppression
(b) Over-rev limitation
(c) Anti-theft provision

The system was tried on varous makes of car and was found to work very well, even on those with very dubious electrical systems. Four connections are all that are required and *no* modifications need be carried out to rev counters or tachometers.

It should be noted that although the cars tested were four cylinder, I see no reason why the system shouldn't work equally well on six or eight cylinder engines.

CIRCUIT

Resistor R1 supplies the contact breaker with approximately 120mA. This is sufficient current to wet the points to prevent corrosion and provide a low impedance source for the differentiator (Fig. 1).

The differentiator is formed by components C1, R1, D3, R2, R3, VR1, R4, D2, R5 and R8. R5 and R8 are also a potential divider to the input of TR2. VR1 sets the upper revolution limit, R4 being normally short circuited by the anti-theft switch and is selected according to the maximum revs required before the engine starts to misfire.

The anti-theft switch is obviously mounted discretely under the dash or other convenient place.

The time constants on the positive half cycle of the differentiator (as the points open) mainly consists of R2 as D2 is conducting; D3 also conducts, raising the base of TR2 to its triggering potential, i.e. 2 volts. As the points close the output across C1 swings negative, D2 and D3 are non-conducting and C1 now discharges through R3 and VR1.

The time constant on the positive swing (points open) is arranged to allow C1 to be fully charged at the shortest dwell time or maximum revs (Fig. 2a). When the points close the negative output swings to −12 volts approximately, Fig. 2b. Now as the time constant is longer the voltage across C1 becomes progressively larger (−ve) as the revs are increased, therefore, eventually a point will be reached where the positive output pulse will be below the trigger voltage of TR4 and engine misfire will result (Fig. 2c). Point bounce suppression is effected in the same way. The bounce occurs just after closure so as C1 has had very little time to discharge the resulting pulse is well below the trigger potential of TR2 (Fig. 2c).

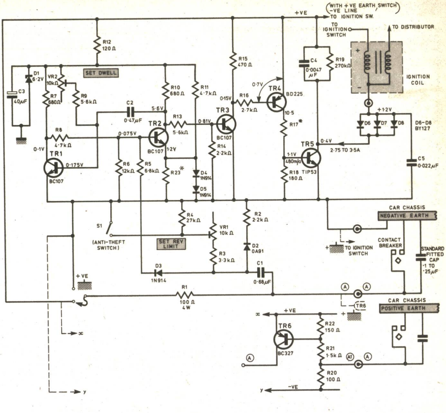


Fig. 1. Assisted Ignition System

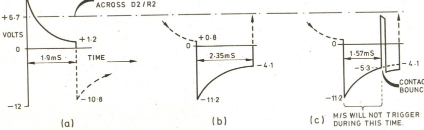


Fig. 2. Differentiator output waveforms at 7,000 rpm

MONOSTABLE AND OUTPUT STAGE

The monostable is conventional except for the offset diodes D4 and D5 which, in conjunction with the base emitter voltage of TR2 and D3, define the triggering potential.

The output pulse width is set within the limits of 1·9ms to 5·5ms with VR2 ("Set Dwell").

Regulating the 6·2 volt supply ensures a constant pulse width, even if there is a considerable change in battery voltage.

The negative going pulse is taken from TR2 collector to TR3 base via R13 which turns off TR3, TR4 and TR5. R17 is chosen to fully bottom TR4.

The output transistor TR5 carries all the coil current and is driven as a fast switch. D6, 7 and 8 protect TR5 from the negative swing from the ignition coil. When TR5 is turned off the collector swings to approximately 400 volts. D6, 7 and 8 conduct, charging C4 to this potential, as the potential at the anodes of the diodes moves below that on the cathode D6, 7 and 8 become non-conducting so isolating TR5 from the negative transient. The discharge time of C4 is through R19.

By the time TR5 is ready to turn on again the voltage across C4 will be approximately +24 volts, so the remaining charge left in C4 will not damage TR5.

TR5 must be mounted on a heatsink of 18 s.w.g. aluminium of not less than 4 square inches.

CONSTRUCTION

The prototype was constructed on 0·1in copper strip board and mounted in an "MK" wall mounting box with a cover plate; this was found to be eminently suitable as it can be made almost watertight. There is no need to screw down the component board as this can be made a snug fit, also if the cables are all taken out from one side in the event of service, the top plate can be unscrewed and the whole panel hinged out for service.

A recommended layout is shown in Fig. 4 and is by no means critical with the exception of the components R17, D6, 7 and 8 which run warm; these must be mounted away from the panel.

Leads carrying high currents, i.e. 100 milliamps or more, should not have long lengths of print between them unless a wire link is also inserted (my experience is that if you don't do this, the print will fuse at the holes, this of course being the weakest point).

If the construction is done on 0·1in matrix board, the heavy duty auto cables will not pass through the holes so the use of Veropins is a good idea.

The cover plate can be drilled to accept TR5 and heat sink.

COMPONENTS . . .

Resistors

R1	100Ω 4W wirewound
R2	2·2kΩ
R3	3·3kΩ
R4	27kΩ
R5	6·8kΩ
R6	12kΩ
R7	680Ω
R8	4·7kΩ
R9	5·6kΩ
R10	680Ω
R11	4·7kΩ
R12	120Ω 0·5W 5% carbon film
R13	5·6kΩ
R14	2·2kΩ
R15	470Ω 0·5W 5% carbon film
R16	2·7kΩ
R17	18–22Ω 11W wirewound (see text)
R18	180Ω
R19	270kΩ

All $\frac{1}{4}$W 5% carbon film except where otherwise stated

Capacitors

C1	0·68µF 63V
C2	0·47µF 63V
C3	40µF 16V
C4	0·0047µF 1,500V polyester paper
C5	0·022µF 1,500V polyester paper

Potentiometers

VR1	10kΩ miniature preset
VR2	10kΩ miniature preset

Diodes

D1	BZY88–6·2 400mW Zener
D2	OA91
D3–D5	1N914 (3 off)
D6–D8	BY127 (3 off)

Transistors

TR1-TR3	BC107 (3 off)
TR4	BD225 or TIP30
TR5	TIP53

For positive earth systems the following are required:

TR6	BC327
R20	100Ω 4W wirewound
R21	1·5kΩ $\frac{1}{4}$W 10% carbon
R22	150Ω $\frac{1}{4}$W 10% carbon

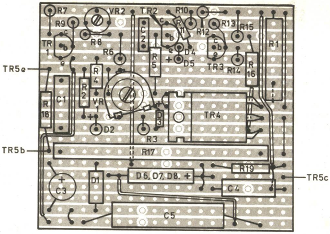


Fig. 4. Component layout on Veroboard

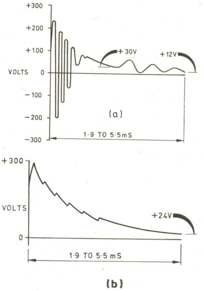


Fig. 3(a). Waveforms at anodes of D6, 7, 8; (b) at collector of TR5

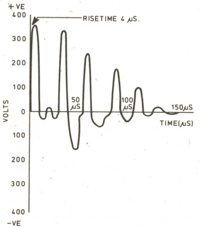


Fig. 5. Output across coil primary

SETTING UP

Set VR1 to its minimum resistance and run the engine to its correct operating temperature.

With standard production car engines VR2 can be set to the centre or three-quarters of its maximum travel; with high performance engines (where revs of 7,000 or more are to be expected) VR2 must be set with a 'scope connected to the anodes of D6, 7 and 8.

With the engine at tick-over the waveform should be that shown in Fig. 3a. Adjust VR2 to show facsimile ringing.

VR1 can now be set to limit maximum revs. With the car at rest bring the revs up to the required maximum and adjust VR1 so that the engine just begins to misfire. Now seal both components with sealing wax.

COIL TUNING

This can only be done using an oscilloscope. Start with a value of 500 pf and bridging with progressively larger values; aim for a waveform approximately as that in Fig. 5. If an oscilloscope is not available the specified value will be approximately correct.

If the unit is going to be used on racing engines and revs in excess of 7,000 are to be expected, the monostable time constant can be reduced down to the actual active period of the coil, 150 to 200 microseconds, this being done by lowering the value of C2 only.

INTRUDER ALARM

A. Chadwick

THIS car burglar alarm incorporates many of the attractive features of previously published circuits.

In operation is is enabled and disabled by a hidden switch in the interior of the car. There is a delay between applying the switch and the enabling of the alarm, giving time for leaving the vehicle.

The alarm is triggered by any load put on the battery; for example the interior light on opening the door.

A shorter delay exists between triggering and any audible output, giving time for the circuit to be disabled.

ALARM

The actual alarm consists of pulsed operation of the horn. After a set time the horn is switched off, and the alarm reverts to the enabled state, ensuring that false triggering does not lead to a flat battery.

CIRCUIT

Operation of the enable switch S1 causes the output of the R-S flip-flop, formed by IC1a and IC1b, to go to logical zero. After a delay determined by VR1 and C2, the input to IC1c goes to zero. This allows any triggering pulses from TR1, C5, D2 and VR3 caused by a load being put on the battery to set the output of the R-S flip-flop IC2a, IC2b to logical one.

After another delay, caused by VR2/C4 monostable IC2c, IC2d is triggered, enabling the astable multivibrator IC3a, IC3b and thus producing pulsed operation of the horn via TR2, TR3, D6 and relay RLA.

TRIGGER GUARD

Triggering of the monostable causes flip-flop IC2a, IC2b to be reset via IC3c, IC3d. R4, C3 cause the reset to IC2b to be held for a short interval after the end of the monostable timing cycle to prevent re-triggering of the alarm by the horn or relay RLA.

Disabling of the alarm resets both the flip-flops and the monostable.

All i.c.s are CMOS 4001 quad 2-input NOR gates. D4 protects the circuit against incorrect supply polarity which would quickly destroy the i.c.s. The contacts of RLA must be fairly substantial, as they carry the full horn current.

VR1, VR2 were set to give exit and entry delays of 80 seconds and 15 seconds respectively. R9, C6 gave an alarm time of about 3·5 minutes, at a frequency (governed by R10, C7) of 0·4Hz.

COMPONENTS . . .

Resistors

R1, R2	1MΩ (2 off)
R3	1kΩ
R4	470kΩ
R5	1kΩ
R6	1MΩ
R7, R8	1kΩ (2 off)
R9	10MΩ
R10	4·7MΩ

All 10% ½W carbon

Capacitors

C1	150μF elect 25V
C2	150μF elect 16V
C3	4·7μF elect 63V
C4	150μF elect 16V
C5	0·1μF
C6	22μF elect 16V
C7	0·33μF

Potentiometers

VR1, VR2	1MΩ miniature preset (2 off)
VR3	100kΩ miniature preset

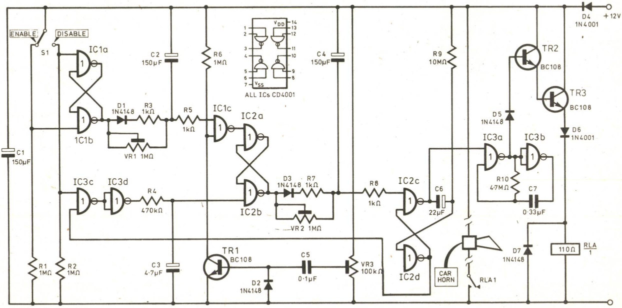
Semiconductors

IC1–IC3	CD4001 (3 off)
TR1–TR3	BC108 (3 off)
D1–D3	1N4148 (3 off)
D4, D6	1N4001
D5, D7	1N4148

Miscellaneous

S1—Single pole double throw switch

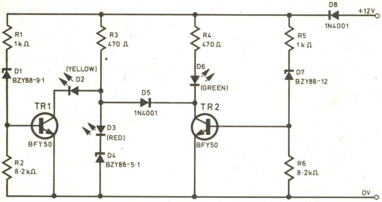
RLA—12V, 110Ω (R.S. 348–835)



Circuit of Intruder Alarm

BATTERY STATE INDICATOR

A. M. Owen



MANY car owners take their battery for granted, rarely giving it the maintenance it requires. As the winter nights advance the demands made on this vital power source increase. When you combine this with the inevitable ageing process and the diminishing ability to store a charge for a long period, the requirement for a simple aid to continuous battery voltage monitoring is obvious.

The indicator was therefore designed to forestall any incipient failure by providing "at a glance" information on battery state with three coloured l.e.d.s; green indicating a battery voltage adequate for normal use; yellow, that the voltage is fairly low and red that there is a failure in the electrical system, such as a dead cell, poor connection, defective regulator or generator.

PRINCIPLE OF OPERATION

An upper and lower battery voltage limit is set by selection of two Zener diodes which allow the transistors to be turned on at set points. These are in turn interconnected via a conventional diode and l.e.d.s to give a display of the state of the car's battery.

When the car's battery is in top condition, its output voltage will be around 14V and of course even higher when charging. This potential is applied, via D8 (reducing it by some 0·8V), through R5, D7 and R6 to the base of TR2 which will be turned "on" causing D6 to illuminate via R4. TR2 at this time, effectively places a short-circuit across the rest of the circuit via D5 preventing D2 and D3 from emitting light as the potential across them is only some 2V.

As the battery voltage becomes lower, TR2 begins to turn off as the threshold of D7 is reached. This allows D2 to start to come on as TR1 has all the time been turned on via R1, D1, R2. The current thus drawn via R3 precludes D3 from illuminating as the potential across it and D4 is not above the Zener level.

Eventually, at still lower battery voltage, TR1 will begin to turn off in the same manner as for TR2, allowing the potential at the junction of D2, D3, D5 to rise in excess of the 5V Zener level of D4 which begins to pass current and illuminates D3.

Zener diodes may be selected for other switching points and/or battery voltages.

COMPONENTS . . .

Resistors	
R1/R5	1kΩ
R2/R6	8·2kΩ
R3/R4	470Ω
All ½W 10% carbon	
Semiconductors	
TR1, TR2	BFY50 (2 off)
D1	BZY88-9·1
D2, D3	TIL209 (Yellow, red)
D4	BZY88-5·1
D5	1N4001
D6	TIL209 (Green)
D7	BZY88-12
D8	1N4001

Battery Voltage (Vb)	**L.e.d. Illuminated**
Vb⩽10V	Red (D3)
10V<Vb<12V	Yellow (D2)
Vb⩾12V	Green (D6)

POLARITY INVERTER

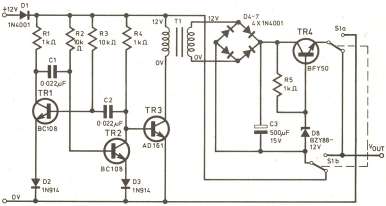
C. D. Williams

THE circuit illustrated was originally designed to enable a negative earth eight-track player to be used in a car with a positive earth, but other uses are obvious, since polarity is reversible.

CIRCUIT

Diode D1 is arranged to prevent incorrect connection to supply. D2 and 3 increase the V_{be} ratings of TR1 and 2 which are connected as a multivibrator operating at about 700Hz.

The output of this is buffered by the AD161 which drives the transformer T1. This must be a low voltage (12V) high current (~1A) one to one transformer, which are rare and expensive. The solution was to use a low voltage mains transformer with individual 12V secondaries and ignore the primary and use the two secondaries. Components D4–8, C3, R5 and TR4 rectify and stabilise the output at 12·6V which is floating relative to the supply rails.



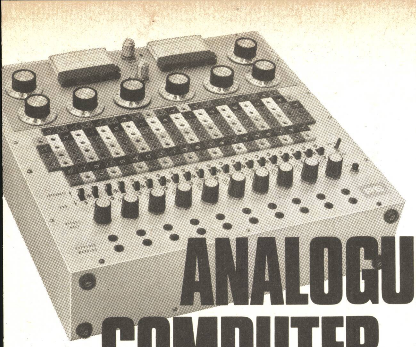
COMPONENTS . . .

Resistors	
R1	1kΩ
R2/R3	10kΩ
R4/R5	1kΩ
Capacitors	
C1, C2	0·022uF (2 off)
C3	500μF elect. 15V

Semiconductors	
TR1, TR2	BC108 (2 off)
TR3	AD161
TR4	BFY50
D1, D4–D7	1N4001
D2, D3	1N914
D4	BZY88-C12V 400mW

Miscellaneous

S1 s.p.d.t. T1–240V prim, 12–0–12V, 0·8A sec



★ Wiring

★ Testing

★ Programming

ANALOGUE COMPUTER

P. J. KRONIS B.Sc.

PART 3

AFTER the p.c.b.s have been assembled and checked, all the components should be fitted into the case with the overload warning p.c.b. mounted on the base of the box using 6BA screws. With all the components mounted in the case the coefficient multipliers and the two panel meters should be wired first, following the wiring diagram shown in Fig. 3.1. Resistors R6, R7 and the links shown in Fig. 3.2 should be wired to each of the ten computing amplifiers. The wiring to the relay board and main p.c.b. is via eight edge connectors and to ease the problem of wiring these connectors a wiring schedule is given in Fig. 3.3. The numbering and layout arrangement of the patch panel and switches is given in Fig. 3.4.

The main p.c.b. is mounted above the patch panel and the relay board above the offset null potentiometers as shown in the photograph. After the computer wiring has been completed and checked a ±15V power supply should be connected to the unit and the following test procedures followed.

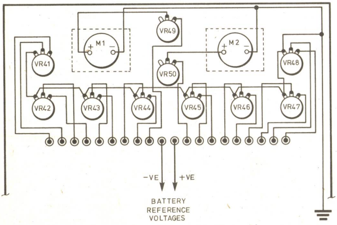
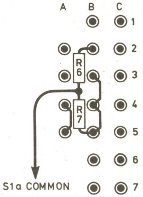


Fig. 3.1. Wiring diagram for the coefficient multipliers and panel meters

THE OFFSET NULL TRIM PROCEDURE

Set all the amplifiers to "add" by pushing all the slide switches down. Put the computer into the "compute" mode using the mode control switch and turn the sensitivity of the meters down as far as possible. Connect the output of the first amplifier (A1) to meter 1 (M1). Ground one of the ×10 inputs of A1. This can be done by touching one end of the wire lead on the case. Connect the power supply and switch on. Increase the sensitivity of M1 gradually until the needle deflects to maximum if possible. Bring the needle back to zero by adjusting the offset null potentiometer of amplifier A1. Increase the sensitivity of the meter and repeat the same procedure until the needle is on zero when the meter is at maximum sensitivity.

Decrease the sensitivity fully and repeat the trim procedure for all amplifiers in the same way.



X and Y inputs
Common outputs
Coefficient multiplier input
Coefficient multiplier output
Initial conditions
Amplifier outputs
Amplifier inputs (X1)
Amplifier inputs (X10)
Spare socket
Integrate with nose gain of one
Integrate with nose gain of ten

Fig 3.2. Link wiring for amplifiers and multipliers

Edge Connector 1

From	To
pin 3	A3 Patch Panel
pin 4	Earth
pin 5	A2 Patch Panel
pin 6	−15V Supply
pin 7	A4 Patch Panel
pin 8	Edge Connector 6 pin 10
pin 9	C5 Patch Panel
pin 10	C4 Patch Panel
pin 11	C3 Patch Panel
pin 12	C2 Patch Panel
pin 13	TB1 Terminal Block
pin 14	VR51
pin 15	Edge Connector 6 pin 11
pin 16	E5 Patch Panel
pin 17	E4 Patch Panel
pin 18	E3 Patch Panel
pin 19	E2 Patch Panel
pin 20	TB2 Terminal Block
pin 21	VR52
pin 22	Edge Connector 6 pin 14
pin 23	G5 Patch Panel
pin 24	G4 Patch Panel
pin 25	G3 Patch Panel
pin 26	G2 Patch Panel
pin 27	TB3 Terminal Block
pin 28	VR53

Edge Connector 2

From	To
pin 1	Edge Connector 6 pin 15
pin 2	J5 Patch Panel
pin 3	J4 Patch Panel
pin 4	J3 Patch Panel
pin 5	J2 Patch Panel
pin 6	TB4 Terminal Block
pin 7	VR54
pin 8	Edge Connector 6 pin 18
pin 9	L5 Patch Panel
pin 10	L4 Patch Panel
pin 11	L3 Patch Panel
pin 12	L2 Patch Panel
pin 13	TB5 Terminal Block
pin 14	VR55
pin 15	Edge Connector 5 pin 19
pin 16	N5 Patch Panel
pin 17	N4 Patch Panel
pin 18	N3 Patch Panel
pin 19	N2 Patch Panel
pin 20	TB6 Terminal Block
pin 21	VR56
pin 22	Edge Connector 5 pin 20
pin 23	Q5 Patch Panel
pin 24	Q4 Patch Panel
pin 25	Q3 Patch Panel
pin 26	Q2 Patch Panel
pin 27	TB7 Terminal Block
pin 28	VR57

Edge Connector 3

From	To
pin 3	Edge Connector 5 pin 23
pin 4	S5 Patch Panel
pin 5	S4 Patch Panel
pin 6	S3 Patch Panel
pin 7	S2 Patch Panel
pin 8	TB8 Terminal Block
pin 9	VR58
pin 10	Edge Connector 5 pin 24
pin 11	U5 Patch Panel
pin 12	U4 Patch Panel
pin 13	U3 Patch Panel
pin 14	U2 Patch Panel
pin 15	TB9 Terminal Block
pin 16	VR59
pin 17	Edge Connector 5 pin 27
pin 18	W5 Patch Panel
pin 19	W4 Patch Panel
pin 20	W3 Patch Panel
pin 21	W2 Patch Panel
pin 22	TB10 Terminal Block
pin 23	VR60
pin 24	X2 Patch Panel
pin 25	X4 Patch Panel
pin 27	X3 Patch Panel

Edge Connector 4

From	To
pin 2	+15V Supply
pin 3	VR51
pin 4	B6 Patch Panel
pin 5	S1d Add
pin 6	B5 Patch Panel
pin 7	C6 Patch Panel
pin 8	VR52
pin 9	D6 Patch Panel
pin 10	S2d Add
pin 11	D5 Patch Panel
pin 12	E6 Patch Panel
pin 13	VR53
pin 14	F6 Patch Panel
pin 15	S3d Add
pin 16	F5 Patch Panel
pin 17	G6 Patch Panel
pin 18	VR54
pin 19	H6 Patch Panel
pin 20	S4d Add
pin 21	H5 Patch Panel
pin 22	J6 Patch Panel
pin 23	VR55
pin 24	K6 Patch Panel
pin 25	S5d Add
pin 26	K5 Patch Panel
pin 27	L6 Patch Panel

Edge Connector 5

From	To
pin 2	VR56
pin 3	M6 Patch Panel
pin 4	S6d Add
pin 5	M5 Patch Panel
pin 6	N6 Patch Panel
pin 7	VR57
pin 8	P6 Patch Panel
pin 9	S7d Add
pin 10	P5 Patch Panel
pin 11	Q6 Patch Panel
pin 12	VR58
pin 13	R6 Patch Panel
pin 14	S8d Add
pin 15	R5 Patch Panel
pin 16	S6 Patch Panel
pin 17	VR59
pin 18	T6 Patch Panel
pin 19	S9d Add
pin 20	T5 Patch Panel
pin 21	U6 Patch Panel
pin 22	VR60
pin 23	V6 Patch Panel
pin 24	S10d Add
pin 25	V5 Patch Panel
pin 26	W6 Patch Panel

Edge Connector 6

From	To
pin 3	−15V Supply
pin 4	S2c Common
pin 5	S1c Common
pin 9	TB1 Terminal Block
pin 10	S1b Add
pin 11	S2b Add
pin 12	TB2 Terminal Block
pin 13	TB3 Terminal Block
pin 14	S3b Add
pin 15	S4b Add
pin 16	TB4 Terminal Block
pin 17	TB5 Terminal Block
pin 18	S5b Add
pin 19	S5a Common
pin 20	S4c Common
pin 21	S3c Common
pin 22	S11a Compute
pin 23	TB2 Terminal Block
pin 24	TB1 Terminal Block
pin 28	Earth, Edge Connector 7 pin 3

Edge Connector 7

From	To
pin 1	S1a Integrate
pin 2	S2a Integrate
pin 3	Edge Connector 7 pin 4
pin 4	Edge Connector 7 pin 7
pin 5	S3a Integrate
pin 6	S4a Integrate
pin 7	Edge Connector 7 pin 8
pin 8	Edge Connector 8 pin 9
pin 9	S5a Integrate
pin 10	TB5 Terminal Block
pin 11	TB4 Terminal Block
pin 12	TB3 Terminal Block
pin 13	S7c Common
pin 14	S6c Common
pin 18	TB6 Terminal Block
pin 19	S6b Add
pin 20	S7b Add
pin 21	TB7 Terminal Block
pin 22	TB8 Terminal Block
pin 23	S8b Add
pin 24	S9b Add
pin 25	TB9 Terminal Block
pin 26	TB10 Terminal Block
pin 27	S10b Add
pin 28	S10c Common

Edge Connector 8

From	To
pin 1	S9c Common
pin 2	S8c Common
pin 3	+15V Supply
pin 4	TB7 Terminal Block
pin 5	TB6 Terminal Block
pin 9	Edge Connector 8 pin 12
pin 10	S6c Integrate
pin 11	S7a Integrate
pin 12	Edge Connector 8 pin 13
pin 13	Edge Connector 8 pin 16
pin 14	S8a Integrate
pin 15	S9a Integrate
pin 16	Edge Connector 8 pin 17
pin 18	S10a Integrate
pin 19	TB10 Terminal Block
pin 20	TB9 Terminal Block
pin 21	TB8 Terminal Block
pin 22	Reset Switch (S12)

Fig. 3.3. Wiring Schedule

Wiring Schedule—*cont.*

From	To
S1b, S1d Common	TB1 Terminal Block
S2b, S2d Common	TB2 Terminal Block
S3b, S3d Common	TB3 Terminal Block
S4b,S4d Common	TB4 Terminal Block
S5b, S5d Common	TB5 Terminal Block
S6b, S6d Common	TB6 Terminal Block
S7b, S7d Common	TB7 Terminal Block
S8b, S8d Common	TB8 Terminal Block
S9b, S9d Common	TB9 Terminal Block
S10b, S10d Common	TB10 Terminal Block
Reset Button (S12)	S11b Compute
S11a	+15V Supply
S11b	−15V Supply
−15V Supply	VR51 Wiper
VR51 Wiper	VR52, 53, 54, 55, 56, 57, 58, 59, 60 (Wipers)

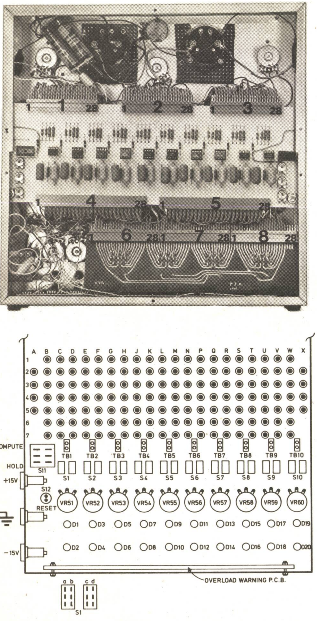

1
28
2
28
1
3
28
1
4
28
1
5
28
6
28
1
7
28
1
8
28
A B C D E F G H J K L M N P Q R S T U V W X
1
2
3
4
5
6
7
COMPUTE
HOLD
+15V
S11
TB1 TB2 TB3 TB4 TB5 TB6 TB7 TB8 TB9 TB10
S1 S2 S3 S4 S5 S6 S7 S8 S9 S10
S12
RESET
VR51 VR52 VR53 VR54 VR55 VR56 VR57 VR58 VR59 VR60
D1 D3 D5 D7 D9 D11 D13 D15 D17 D19
−15V
D2 D4 D6 D8 D10 D12 D14 D16 D18 D20
OVERLOAD WARNING P.C.B.
a b
c d
S1

Fig. 3.4. Layout arrangements for edge connectors, patch panel and switches

MODE CONTROL TEST

Set amplifier A1 to "integrate", and the mode to "compute" and monitor the output with one of the meters. Apply a voltage to a ×1 input. The needle should deflect gradually in the positive direction, if the applied input voltage is negative, and vice-versa, until the amplifier saturates. When this happens, adjust the meter sensitivity so that the needle is at maximum deflection. Put the computer in the "hold" mode and press the "reset" switch. The needle should go to zero. Release "reset" and switch to "compute". The needle will again start to deflect and this time switch the mode to "hold" before the amplifier saturates. The needle should then stop moving. Carry out this test with all the amplifiers. While doing this, observe the operation of the overload warning circuit. The appropriate l.e.d. should come on when the amplifier output exceeds +11V or goes below −11V. Check both positive and negative operation by applying both positive and negative input voltages.

The above tests are not complete by any means but any remaining problems will show up when the examples described under "programming" are attempted.

COMPONENTS . . .

Resistors

R6, R7 100kΩ $\frac{1}{4}$W carbon (2 off)

Potentiometers

VR41–VR48 100 kΩ linear (8 off)
VR49–VR50 300 kΩ linear (2 off)

Miscellaneous

1 off d.p.d.t. switch (R.S. type 316–793)
20 off d.p.d.t. sub-min slide switch
2 off 50–0–50μA (ME15 T40 Watford Electronics)
1 off Push button (R.S. type 337–914)
151 off Square 4mm panel mounted sockets (55 red, 32 yellow, 22 green, 21 white, 21 black)
8 off Skirted knob
12 off Plain knob
6 off 28 way edge connector 0·1in matrix
2 off 28 way edge connector 0·15in matrix
Banana plugs (as required)

PROGRAMMING

It has already been mentioned, that it is necessary to form a mathematical model of the problem to be solved and the computer cannot help us to do this, but being very faithful however, it will happily try to solve a problem even if the wrong information is fed into it. Fortunately, in such cases the programmer could get an indication that something had gone wrong by studying the results which are usually meaningless. The general rule "Garbage In, Garbage Out" (well known to digital computer programmers) applies here also. Unfortunately, error checks cannot be incorporated in the analogue programs, as is the case with digital programs. It is important therefore to adopt a methodical procedure for programming to avoid errors.

Having formed the mathematical model, the equations are rearranged and a flow diagram is constructed which satisfies the equations. All values to be input and all computing elements to be used, are marked on the flow diagram to avoid confusion. Referring to the diagram the computer is then programmed by patching the panel. This procedure will be illustrated by several examples. The flow diagrams are constructed using standard symbols representing computing elements. Some of these have already been given. Fig. 3.5 shows all the symbols to be used in this article.

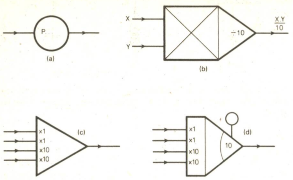


Fig. 3.5. Computing element symbols: (a) coefficient multiplier; (b) Four quadrant multiplier; (c) Summer; (d) Integrator with initial conditions.

As a first example let us examine the operation of potentiometers, adders and integrators, using simple experiments.

Apply a reference voltage to the input of P1 and connect the output to M1. Adjust the sensitivity of M1 so that when P1 is at maximum, M1 deflects fully. Operate the potentiometer and observe the results.

Switch the power on and calibrate M1 by applying a known voltage (e.g. supply voltage), to read 15V at full deflection. Switch A1 to "add" and apply the output of P1 to the input of A1 and the output of A1 to M1. The flow diagram and patch panel connections are shown in Fig. 3.6. Test all A1 inputs in turn and observe the gain of the adder each time.

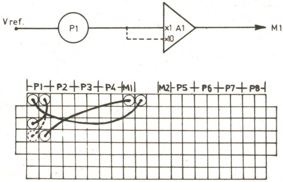
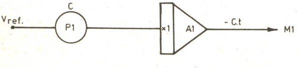


Fig. 3.6. Flow diagram and patch panel layout for the potentiometer example

To examine the operation of the integrators, we can integrate various functions and study the results. First let us see what happens when we integrate a constant, C. The mathematicians will immediately give us the answer as C.t + K, where t is the variable (time in this case) and K is another constant. This is a straight line, of gradient C and passing through the origin, if we have no initial conditions, i.e. C = 0 at t = 0. To verify this we can set up the program shown in Fig. 3.7.



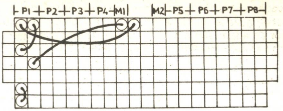


Fig. 3.7. Flow diagram and patch panel layout for the integration example

To run this program follow these steps:

(1) Check A1 is in "integrate"
(2) Computer mode: "hold"
(3) Switch power on
(4) Press reset for a few seconds and release
(5) Switch to "compute" and observe the meter.

Vary the value of C by adjusting P1 and repeat the above steps. If an X–Y plotter is available the results can be plotted for different values of C. The graph would look like Fig. 3.8. With C set to 1 volt the output should increase at 1 volt per second (C = C.t). This can be verified by timing the deflection of the needle.

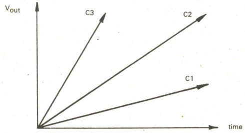


Fig. 3.8. Graph showing the resultant curves when various values for the constant C are integrated

These examples serve to illustrate the use of the analogue computer as a function generator. By integrating a step function we obtained a ramp function, the slope of which we could easily control. The ramp function can be integrated again to produce a square law function. This is shown in the flow diagram in Fig. 3.9. Still higher power functions can be obtained by successive integrations.

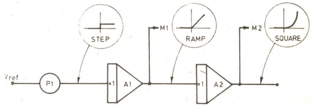


Fig. 3.9. By integrating waveforms the analogue computer can be used as a function generator

INITIAL CONDITIONS EXAMPLE

In the previous integrator examples we assumed that at time t = 0 all variables had zero value. Suppose that we wanted to give a value to the output of the integrator, before the computation begins. It is not difficult to imagine examples where this might be used. We may for example like to investigate the flight of a rocket, not from the point of launch but from some height above the launching pad, at which the rocket will have some velocity and acceleration. To illustrate the use of initial conditions we can repeat the first integrator example, but this time we are going to give an initial value to the integrator output of 5V. We therefore require 5V to be applied to the initial condition socket of A1. Since the value of the reference voltages is only about 1·5V, we shall have to multiply this value. This we can do with the aid of an adder and a potentiometer. The flow diagram and patch panel connections are shown in Fig. 3.10.

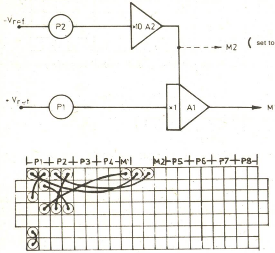


Fig. 3.10. Flow diagram and patch panel layout for the initial condition example

To run this program follow these steps after the panel has been patched.

(1) Switch power on
(2) Amplifier A1 integrating and A2 adding
(3) Computer mode: "hold"
(4) Monitor A2 output and adjust to 5V using P2
(5) Set output of P1 to 1V
(6) Press "reset" for a few seconds and release (Output of A1 should now show 5V)
(7) Switch mode to "compute" and observe M1.

The initial condition value is invariably formed using an adder and a potentiometer, unless of course the exact value is available. It is therefore common practice not to show these two computing elements, but simply to note the value being applied to the initial condition socket as shown in Fig. 3.11.

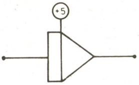


Fig. 3.11. Initial condition symbol

Another point worth noting here is that it is not essential for the potentiometer to precede the adder as shown in the flow diagram. In fact in such cases it is better for the amplifier to precede the potentiometer, as the former presents a higher input impedance to the battery than the latter and therefore saves battery energy.

ENGINEERING PROBLEMS

Consider a mass M supported on a spring of stiffness K. If the mass is disturbed, the system will begin to oscillate about the equilibrium position. Mechanical systems usually have electrical equivalents or vice-versa. The electrical equivalent to the spring mass system is the capacitor inductor series circuit. Both systems are shown in Fig 3.12.

The equation of motion of the spring mass system is $M\ddot{x} + Kx = 0$. The electrical system is described by a similar equation but with electrical symbols substituted for the mechanical ones. The "dot" notation is used where time derivatives are involved. For example, one dot means the first derivative of the variable in question, with respect to time, two dots mean the second derivative and so on. So if x represents displacement, then $\dot{x}$ represents velocity, and $\ddot{x}$ acceleration. The equation can be rearranged so that the highest derivative appears on the left-hand side, with everything else on the right-hand side. This is normal practice when solving a problem on the analogue computer. The equation becomes $\ddot{x} = -\frac{K}{M}x$ and the flow diagram is shown in Fig. 3.13.

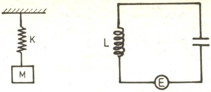


Fig. 3.12. The mechanical spring/mass circuit and its electrical equivalent the inductor/capacitor series circuit

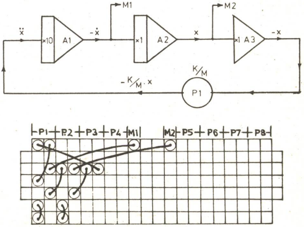


Fig. 3.13. Flow diagram and patch panel layout for the spring/mass example

By integrating $\ddot{x}$ twice we obtain $-\dot{x}$ and x. In our equation, however, we require –x and so A3 is used as a sign inverter. The value K/M is set up on potentiometer P1, the output of which becomes $-K/M \cdot x$. This is equal to $\ddot{x}$ and therefore we can close the loop by connecting the output of P1 back to the input of A1. The system as it stands will not vibrate unless it is disturbed. Theoretically once it is disturbed, it should go on vibrating for ever. In practice, however, we know that this is not true, because of the presence of some damping, due to air resistance in the case of the mechanical system and electrical resistance in the case of the electrical system. The analogue computer should produce results very near to the theoretical predictions, i.e. very little damping should be present. To run this program follow these steps.

(1) Check A1 and A2 are integrating and A3 is adding.
(2) Switch power on.
(3) Switch mode to "compute".
(4) Apply a disturbance to the input of A2 or A3. (This can be done by momentarily touching the input socket, with a wire lead connected to a reference voltage socket. This is equivalent to giving the weight a gentle push.)

(5) Observe the meters and adjust the sensitivity to produce a reasonable needle deflection.

(6) Operate P1 and see what happens to the frequency and amplitude of oscillation.

You should find that a high value of K/M (i.e. high spring stiffness or small mass or both) gives a high frequency and vice versa. The other point to note is that the oscillation is sinusoidal. The output of A1 (i.e. the velocity) is a cosine function, whereas that of A2 (the displacement) is a sine function. There is a phase difference of 90 degrees between the velocity and the displacement. (The mass comes to a momentary stop when the displacement is at a maximum.) This is shown in the graph in Fig 3.14.

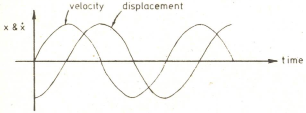


Fig. 3.14. Graph showing the phase difference between velocity and displacement

In this last example we have seen how the analogue computer can be used as a function generator for sine or cosine functions, with variable frequency. The frequency of oscillation is given by

$$f = \frac{1}{2\pi}\sqrt{\frac{K}{M}}\ \text{Hz (cycles per second)}$$

This can be checked by counting the number of cycles in one minute and dividing by 60 to convert to cycles per second. If the value of P1 is set to 1·0 and the input of A1 is multiplying by 10 then K/M = 10 and the frequency should be $f = 1/2\sqrt{10} = 0{\cdot}503$Hz.

NEXT MONTH: PROGRAMMING AND SPECIAL CIRCUITS (conclusion of series)

News Briefs

by Mike Abbott

BUBBLING WITH BITS

THE IDEA of the magnetic bubble conjures up a picture of quivering clusters gurgling their way to the North Pole. In fact powerful magnetic bubble memories are about to "pop" onto the scene from at least two major electronics manufacturers in the near future, one of which is Texas Instruments.

Sample quantities of a new quarter-million-bit bubble memory will be available from T.I. before the end of this year, but at $500 each there probably won't be many P.E. constructors in the queue. (A 92k—bit bubble memory is now in volume production at a price of $100 in 100 unit quantities). The big one however, designated the TIB0303, is full of three micron diameter magnetic bubble domains, and uses separate I/O, minor loop architecture, and features block replication of data. Separate read and write tracks with minor loop data storage are at the heart of this block replicate-based architecture to provide improved performance.

A total of 252 minor loops, each consisting of 1,137 bubble positions, results in a single-chip memory capacity of 286,524 bits. However, 224 loops are utilised resulting in a minimum data capacity of 254,688 bits.

Data bits are written into the write track and exchanged with stored data in the minor loops via swap gates. Data blocks are replicated simultaneously at minor loop and output track junctions, rather than serial duplication which is characteristic of major/minor loop architecture. Consequently, power-down cycle time is significantly reduced from 12·8 milliseconds in the 92K-bit major/minor loop configuration to 12·5 microseconds for block replicate, representing three orders of magnitude improvement.

Other key features include: advanced asymmetric chevron design for improved bubble propagation and transfer, merged data that allows a continuous flow of data bits at the read track, and a dedicated loop for storage of on-chip redundancy information and address synchronisation.

Performance specifications at 100 kilohertz operation are an average access time of 7·3 milliseconds for the first bit of the 224-bit page and a typical power consumption of 0·9 watt for continuous operation. A data-merge function allows a read data of 100K bits per second. Operating temperature is 0° to 50°C with non-volatile storage range of −40° to 85°C.

Bubble control functions are executed by providing current pulses through the appropriate control element on the chip.

The bubble chip is comprised of a gadolinium-gallium garnet substrate upon which a magnetic epitaxial film is grown. Patterns of permalloy metal are deposited on the epitaxial film to define the path of the bubble domains in the presence of a rotating magnetic field. As the field rotates, the bubble domains move under the permalloy pattern in shift register fashion.

The TIB0303 will be offered in a 20-pin dual-in-line package, measuring 30 × 30 × 10mm. The package contains the quarter-million-bit bubble chip surrounded by two orthogonal coils that provide the rotating magnetic field, a permanent magnet set, and a magnetic shield to protect data from external fields.

Taking a systems approach, TI will offer a family of interface and control circuits for the TIB0303 in the second quarter of 1979.

BLINKING GOOD

IF ONE of your projects requires an l.e.d. to wink on-and-off to catch someone's eye, here's something to save you the effort of building a multivibrator to do it.

Available from the Norbain Optoelectronics Division is the first Flashing Light Emitting Diode, Type FRL 4403, to appear on the market. The T $1\frac{3}{4}$ l.e.d. is manufactured in Gallium Arsenide Phosphide technology with a red diffused plastic lens. The built-in integrated circuit flashes the l.e.d. on and off at roughly 3 pulses per second, and can be driven directly by standard TTL and CMOS devices, eliminating the need for external switching circuitry.

Optoelectronic characteristics include a luminous intensity of 1·2mCd (typ), an emission peak wavelength of 650nm, spectral line half width 40nm, operating voltage 5 volts (typ), and current of 20 milliamps (typ).

The l.e.d. gives a large full flood radiating area, wide viewing angle and finds application as a condition warning light, monitoring process control system and in many other applications where warning of failure is essential.

Norbain Optoelectronics Division, Norbain House, Arkwright Road, Reading, Berkshire RG2 0LT.

ON THE LEVELL

THE very popular and stout a.c. microvolt meters, type TM3B, made by Levell Electronics Ltd., have just been upgraded.

The improvements include increased input impedance and meter scale length. A brief specification follows:

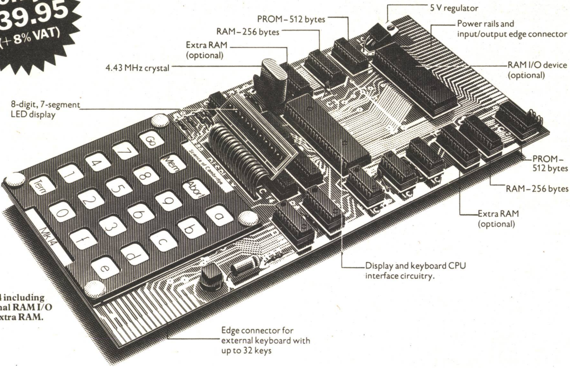
VOLTAGE and dB RANGES: 15µV to 500V. f.s.d. Acc. ±1% f.s.d. ±1µV at 1kHz, −100, −90 . . . +50dB. Scale −20dB/+6dB ref. 1mW/600Ω.

RESPONSE: ±3dB from 1Hz to 3MHz, ±0·3dB from 4Hz to 1MHz above 500µV.

INPUT IMPEDANCE: Above 50mV: 10MΩ<20pf. On 50µV to 50mV: >5MΩ<50pf.

From Science of Cambridge: the new MK 14. Simplest, most advanced, most flexible microcomputer – in kit form.

only £39.95
(+8% VAT)


5 V regulator
PROM – 512 bytes
Power rails and input/output edge connector
RAM – 256 bytes
Extra RAM (optional)
4.43 MHz crystal
RAM I/O device (optional)
8-digit, 7-segment LED display
Go
7
4
1
Term
Mem
8
5
2
0
Abort
9
6
3
f
a
b
c
d
e
Science of Cambridge
MK 14
PROM – 512 bytes
RAM – 256 bytes
Extra RAM (optional)
Display and keyboard CPU interface circuitry.
Edge connector for external keyboard with up to 32 keys

MK 14 including optional RAM I/O and Extra RAM.

The MK 14 is a complete microcomputer with a keyboard, a display, 8 x 512-byte pre-programmed PROMs, and a 256-byte RAM programmable through the keyboard.

As such the MK 14 can handle dozens of user-written programs through the hexadecimal keyboard.

Yet in kit form, the MK 14 costs only £39.95 (+£3.20 VAT, and p&p).

More memory – and peripherals!

Optional extras include:

1. Extra RAM – 256 bytes.
2. 16-line RAM I/O device (allowed for on the PCB) giving further 128 bytes of RAM.
3. Low-cost cassette interface module – which means you can use ordinary tape cassettes/recorder for storage of data and programs.
4. Revised monitor, to get the most from the cassette interface module. It consists of 2 replacement PROMs, pre-programmed with sub-routines for the interface, offset calculations and single step, and single-operation data entry.
5. PROM programmer and blank PROMs to set up your own pre-programmed dedicated applications.

All are available now to owners of MK 14.

A valuable tool – and a training aid

As a computer, it handles operations of all types – from complex games to digital alarm clock functioning, from basic maths to a pulse delay chain. Programs are in the Manual, together with instructions for creating your own genuinely valuable programs. And, of course, it's a superb education and training aid – providing an ideal introduction to computer technology.

SPECIFICATIONS

●Hexadecimal keyboard ● 8-digit, 7-segment LED display ● 8 x 512 PROM, containing monitor program and interface instructions ●256 bytes of RAM ● 4 MHz crystal ● 5 V regulator ● Single 8 V power supply ● Space available for extra 256-byte RAM and 16 port I/O ● Edge connector access to all data lines and I/O ports

Free Manual

Every MK 14 kit includes a Manual which deals with procedures from soldering techniques to interfacing with complex external equipment. It includes 20 sample programs including math routines (square root, etc), digital alarm clock, single-step, music box, mastermind and moon landing games, self-replication, general purpose sequencing, etc.

Designed for fast, easy assembly

The MK 14 can be assembled by anyone with a fine-tip soldering iron and a few hours' spare time, using the illustrated step-by-step instructions provided.

How to get your MK 14

Getting your MK 14 kit is easy. Just fill in the coupon below, and post it to us today, with a cheque or PO made payable to Science of Cambridge. And, of course, it comes to you with a comprehensive guarantee. If for any reason, you're not completely satisfied with your MK 14, return it to us within 14 days for a full cash refund.

Science of Cambridge Ltd,
6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Telephone: Cambridge (0223) 311488

To: Science of Cambridge Ltd, 6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Please send me the following, plus details of other peripherals:

☐ MK 14 Standard Microcomputer Kit @ £43.55 (inc 40p p&p.)
☐ Extra RAM @ £3.88 (inc p&p.)
☐ RAM I/O device @ £8.42 (inc p&p.)

I enclose cheque/money order/PO for £________ (indicate total amount.)

Name________________

Address (please print)________________

PE 11

Allow 21 days for delivery.

Science of Cambridge

You'll learn a lot from Heathkit electronics courses.

Heathkit electronics courses are a most effective way to learn—with fast, reassuring results.

Each course is a complete self-instructional package with clear, concise instructions in everyday language. You follow at your own pace, using modern teaching aids and expert guidance.

Four basic courses to start with.

DC electronics, AC electronics, semi-conductors and electronic circuits. These courses give you a thorough and practical understanding—the key to all knowledge in the field of electronics.

Microprocessors and digital techniques.

The advanced Heathkit courses take you on to higher levels of computer technology and advanced circuit design, using the same easy-to-follow learning system.

Experimenter-Trainers.

With the benefit of increased practical guidance, these optional aids will help you through the courses with exceptional speed.

The finest way to learn.

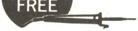
Heathkit courses are used by home students, industrial concerns, technical colleges and schools. They're acknowledged as the finest way to learn. And the range of courses is complete from the earliest stages to the most advanced steps in specialist fields.

Send for the Heathkit Catalogue now.

As well as electronics courses, the Heathkit catalogue contains scores of electronics kits which you can build yourself. Burglar alarms, radios, digital clocks, car tune-up systems, test instruments, metal locators... and an exciting new range of personal computers!

Forty pages packed with exciting kits you'll be proud to make.

Soldering
Iron offer
FREE



When you receive your catalogue you will get details of this free offer worth approximately £4.75.

HEATH
Schlumberger

To Heath (Gloucester) Ltd., Dept: PE 11/78, Bristol Road, Gloucester, GL2 6EE.
Please tick the literature you want and enclose the appropriate amount in postage stamps.

☐ Heathkit Catalogue only (enclose 20p).
☐ 16 page Computer Brochure only (enclose 20p).

Name ______________________

Address ______________________

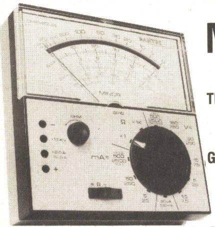
____

Registered in England, number 606177

There are Heathkit Electronics Centres at 233 Tottenham Court Road, London (01-636 7349) and at Bristol Road, Gloucester (Gloucester 29451).

ALCON

BRING YOU THE *NEW* CHINAGLIA



MINOR

POCKET MULTIMETER

THE PROFESSIONAL SOLUTION TO GENERAL MEASUREMENT PROBLEMS

£32·50 inc. VAT.

The best instrument for the workshop, school, toolbox, T.V. shop and anywhere accurate information is needed quickly and simply.

IT OFFERS:

- ★ Single-knob range selection
- ★ 110° Full-view mirror scale and fine line pointer
- ★ Clear unambiguous scales
- ★ A well-damped cylindrical magnet movement with resilient bearings
- ★ 31 ranges providing coverage from 150mV to 1·5kV d.c.; 7·5V to 1·5kV a.c. 50μA to 2·5A d.c.; 25mA to 12·5A a.c.; 10kΩ and 10MΩ resistance and six signal level ranges.
- ★ Accuracy ±2·5% d.c., ±3% a.c. and 2% resistance.

For details of this and other exciting Alcon instruments please write or phone:-

ALCON Instruments Ltd.

19 MULBERRY WALK. LONDON SW3 6DZ TEL: 01-352 1897

---

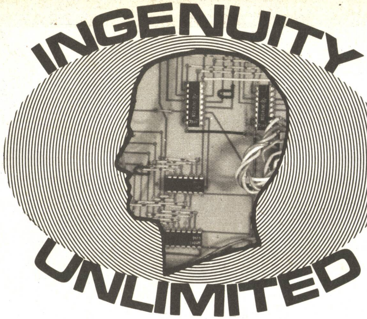
100 PIV 25 Amp S.C.R's Branded for **40p.**
100 PIV 10 Amp BRANDED DIODES @ **15p** each.
3 PIN PLUG AND SOCKET like RS European type with 2 metres of Cable. **75p** pr.
1uf 25v.w. ELECTROLYTIC CAPACITORS 6 for **25p.**
MULLARD PRE-AMPLIFIER I.C. TYPE TAA 435 @ **40p.**
SUB-MINIATURE TANTALUM CAPACITOR. 4.7uf 10v.w. @ 6 for **25p.**
6 WATT WIRE WOUND POTENTIOMETERS 1.2K @ **22p** each.
0.2" LED's Red @ **15p,** Green @ **18p.**
ITT CAPACITORS TYPE PMT-2R Miniature .1uf 100v.w. @ **20p** doz.
DISC CERAMICS – .1uf 18v.w. @ **25p** doz.
5 TURN POTENTIOMETERS 5K @ **£1, TEN TURN** 1K, 5K, 100K @ **£1.50.**
400mW UNMARKED GOOD ZENERS 3.6v, 6.8v, 10v, 11v, 12v, 13v, 16v, 24v, 30v, 33v, 36v. All at 10 for **40p.**
GENERAL PURPOSE FETS E111 @ **12p,** 5 for **50p,** E112 @ **10p,** 5 for **45p,** E113 @ **12p,** 5 for **50p,** E174 @ **22p,** 5 for **85p,** VHF J310 @ **20p.**
200 ASSORTED ¼, ⅛ WATT RESISTORS for **75p.**
50. 2 WATT ZENERS Assorted untested for **57p.**
IS44 SILICON DIODES at **25p** doz.
10 ASSORTED MULTI TURN PRE-SET POTENTIOMETERS @ **60p.**
100 ASSORTED MULLARD C280 CAPACITORS for **57p.**
TBA 120S FM I.C's Untested with data. 6 for **60p.**
MULLARD ELECTROLYTICS 2240uf 40v.w. @ **40p,** 4500uf 25v.w. @ **40p,** 5000uf 10v.w. @ **15p,** 6400uf 25v.w. @ **25p.**
SUB-MINIATURE 8 OHM LOUDSPEAKERS 1¾" dia – @ **75p.**
12 X BAND VARACTOR DIODES for **£1.**
X BAND GUNN DIODES with data @ **£1.65** each.
ILLUMINATED EDGEWISE 200uA METERS at **£1.25** each.
DIE CAST BOXES 4" × 2" × 1" @ **55p,** 4 7/16" × 2 7/16" × 1½" @ **65p,** 4¾" × 2 9/16" × 1 9/16" @ **85p,** 6" × 3 3/16" × 2" @ **£1.15.**
60 ASSORTED WIRE WOUND RESISTORS 1 to 10 watt @ **57p.**
MINIATURE ROTARY SWITCHES 2 Pole 4 way @ **20p.**
50. BC 107-8-9 TRANSISTORS Untested @ **57p.**
50. AC 128 TRANSISTORS Branded but untested @ **57p.**
ERIE RED CAP .01uf 100v.w. **CAPACITORS** @ **5p** each.
1 Amp TRANSISTORS PNP BCX36 @ **12p,** BCX37 @ **10p.**
100 ASSORTED DISC CERAMICS for **57p.**
30 10XAJ CRYSTALS Assorted between 5100 to 7900KHz @ **£1.10.**
5 WATT NPN DARLINGTON TRANSISTORS @ **20p,** 3 for **50p.**
CLOCK P.C. BOARDS with Buzzar, Mercury Switch, Bridge Rectifier, Transistors etc. No data **£1.**
MEDIUM POWER TRANSISTORS MP 8112 @ **15p,** MP 8512 @ **15p.**
MOS LEVEL SENSOR TAA 320A with data @ **35p.**
20 PHOTO TRANSISTORS DARLINGTONS Untested for **£1.**
MCMURDO 8 PIN PLUGS @ **20p,** 8 Pin Sockets @ **20p,** Covers @ **15p.**
NKT 214 TRANSISTORS equivalent to OC 71 @ **10p,** 6 for **50p.**
MAINS TRANSFORMERS 240 volt input Type 1. 22-0-22 volt 500mA @ **£1.60** (P&P 25p), Type 2. 24 volt Tapped at 14 volt 1 amp @ **£1.30** (P&P 25p), Type 3. 50 volt 10 amp @ **£5.50** (P&P 95p), Type 4. 50 volt 2 amp, 45 volt 500mA @ **£3.50** (P&P 85p), Type 5. 20 volt 1 amp Twice, 10 volt 1 amp twice @ **£4.50** (P&P 95p).
2200uf 100v.w. @ **60p,** 100uf 100v.w. @ 6 for **25p,** 4700uf 63v.w. @ **50p,** 3300uf 63v.w. @ **50p. ELECTROLYTICS.**
2 GHz STRIPLINE NPN TRANSISTORS @ **£1** each.

Please add 20p for post and packing, unless otherwise stated, on U.K. orders under £2.
Overseas orders at cost.

J. BIRKETT

RADIO COMPONENT SUPPLIES

25 The Strait, Lincoln LN2 1JF Tel. 20767



A selection of readers' original circuit ideas. It should be emphasised that these designs have not been proven by us. They will at any rate stimulate further thought.

Why not submit *your* idea? Any idea published will be awarded payment according to its merits.

Articles submitted for publication should conform to the usual practices of this journal, e.g. with regard to abbreviations and circuit symbols. Diagrams should be on separate sheets, not inserted in the text.

Each idea submitted must be accompanied by a declaration to the effect that it is the original work of the undersigned, and that it has not been accepted for publication elsewhere.

741 SUPPLY

WHEN two independent power supplies are used to run 741 circuits, problems can arise if one is loaded more than the other. This is particularly so if the circuits use reference voltages taken from the supply rails, e.g. the comparator in Fig. 1.

The power supply circuit shown (Fig. 2) avoids this by using a negative feedback loop; a 741 sensing the mid-voltage between the two supply rails and controlling the voltage at the bases of the transistor pairs. This feedback keeps the point "A" at zero volts so, provided that the two sensing resistors (R6 and R7) are equal, the two output voltages are equal and opposite.

In the circuit tested AD161, 162 and AC127, 128 transistors were used which could give a ½ amp supply.

M. G. Kiff,
Wallingford, Oxon.

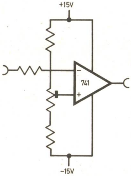


Fig. 1

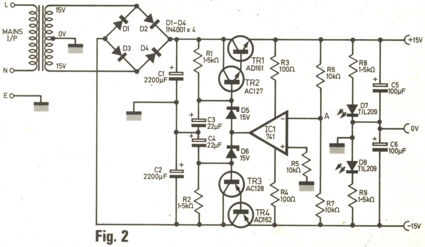


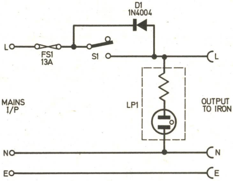
Fig. 2

SOLDERING IRON SIMMER CONTROL

WHEN soldering intermittently it is annoying to wait for the iron to heat up each time, while leaving it on uses up both the bit and electricity. This circuit supplies half power to keep the iron just warm, giving rapid rise to full temperature.

A common type of switched 13A plug is used with a rectifier in parallel with the switch. The rectifier (type 1N4004 is suitable) is soldered, either way round. The neon is left connected as before, giving full and half brightness to indicate power selected.

M. A. Wheatley,
Maidenhead,
Berkshire.



L.F. FREQUENCY METER

THIS instrument is capable of measuring frequencies in the range 10Hz to 100kHz. Four switched ranges are available, these being:

1. 0–100Hz
2. 0–1kHz
3. 0–10kHz
4. 0–100kHz

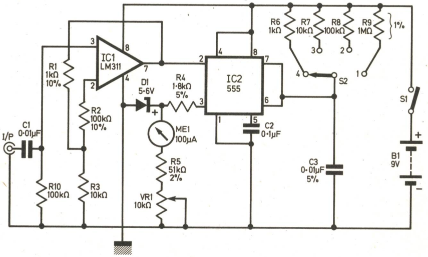
The meter scale is linear to facilitate reading the frequency. The power consumption is 9V at 10mA, and this may be conveniently supplied from a battery.

The first stage of the circuit is an LM311 comparator which converts the input waveform into a square-wave. The LM311 i.c. was chosen because of its low input current and because of its ability to run off a single supply. The output of this i.c. is then fed to the 555 which is connected as a monostable. Hence, the average voltage at the output of IC2 is directly proportional to the frequency at its input. The length of the pulses from the 555 depends on the value of C3 and R6, R7, R8 or R9.

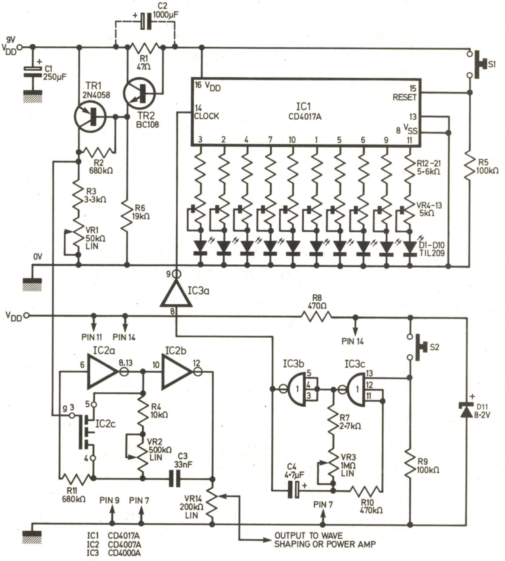
The output of IC2 is fed first to a 5·6V Zener diode via a current limiting resistor. This has the effect of preserving instrument accuracy despite fluctuations in supply voltage. The output from the Zener is then fed to the meter. VR1, a preset potentiometer, is adjusted to calibrate the instrument.

Finally, components that govern the pulse length should be high quality types. R6–R9 need to be 2% or better, and C3 must be a 5% polycarbonate type.

D. P. Akerman,
Dagenham,
Essex.



AUTO-TUNE GENERATOR



THIS circuit enables a preset series of 10 notes to be played over and over again.

With this basic operation, possible applications could be: novel doorbells; background to music synthesis; audio-visual displays, etc. IC1 (CD4017A) is a decade counter which counts one on each positive transition of a clocking oscillator. That is, it applies a high signal to D1, then D2, then D3 and so on up to D10. Depressing S1 resets the counter.

Each note is set by adjusting the current drawn from a particular output (D1 to D10), with VR4–13. A l.e.d. is placed on each output to indicate which note is being played at that moment; they are optional and can be omitted (tuning is much harder without the l.e.d.s). The varying current taken by IC1, as it counts along the preset notes, is monitored by TR2 and R1 which convert the current into a corresponding, changing voltage. TR1 amplifies this and presents it to an audio VCO. VR1 varies the range of notes over which each preset note can be tuned.

IC2 forms the VCO from a CD4007A, IC2a, b being the audio oscillator tuned manually with VR2. IC2c, which is a CMOS f.e.t., is in parallel to VR2 and R4 and so a changing potential on the f.e.t.'s gate will cause a changing frequency. VR14 then attenuates the output signal for an amplifier.

The clock oscillator is a CD4000A (IC3) and oscillates from about 0·2Hz to 5Hz—fully variable with VR3. S2 will stop the oscillator (a tuning aid), and D11 and R8 ensure that the oscillator's fluctuating current doesn't affect the VCO's steady tone.

Finally, C2 can be added for an interesting effect. The whole unit will run from a small 9V battery. IC1, 2 and 3 are CMOS and should be handled with care.

T. D. Davey,
Berkhamsted,
Herts.

TOUCH TUNER

THE circuit shown forms a simple "touch tuner" for use with varicap devices. It is based on the CMOS integrated circuit MC14514 which is a 4 line to 16 line latch/decoder, so up to 16 channels can be switched (if only 8 are required input D can be grounded as shown).

When the strobe input is high the BCD inputs to the i.c. are encoded as 1 of 16 outputs.

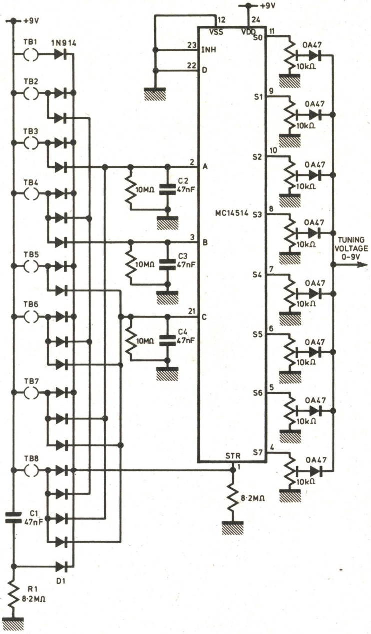
The touch buttons are decoded by the diodes to produce the BCD pattern, at the same time pulling the strobe input high (STR). This selects one of the 16 outputs which drive up to almost V_{dd} which is in turn divided down, by preset potentiometers, to give the tuning voltage that is applied to the tuner via the isolating diodes.

When the touch button is released the state at the BCD input is retained for a short time by the capacitors C2–C4, but the strobe input immediately goes low thus latching the BCD inputs and retaining the selected output.

The circuit formed by C1 and R1 cause a pulse on the strobe input during switch on to reset the tuner to the station selected by the S_0 output.

If it is required that the common contact of the touch buttons be at earth, the decoding diodes could be reversed, the BCD inputs pulled up to V_{dd} together with the capacitors and the strobe input inverted.

K. R. Drage,
Edmonton,
London N9.



RELAYS SIEMENS, PLESSEY, etc. MINIATURE RELAYS

RELAYS. WIDE RANGE OF A.C. and D.C. RELAYS AVAILABLE from stock, phone or write in your enquiries.

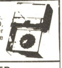
FT3 NEON FLASH TUBE

High intensity multi turn, high voltage, neon glow, discharge flash tube. Design for ignition timing, etc. **£1·50.** P. & P. 25p. (**£1·89** inc. VAT). 3 for **£3.** P. & P. 50p (**£3·78** inc. VAT & P.).

RODENE UNISET TYPE 71 TIMER

0-60 sec. 230V a.c. operation. Incorporating a lapsed time indicator and repeat facilities. A precision motorised timer ideal for process timing, photography, welding, mixing, etc. Price **£6** P. & P. 60p.

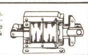
WHY PAY MORE?



MULTI RANGE METER **Type MF15A** a.c. d.c. volts 10 - 50, 250, 500, 1000. Ma 0–5, 0–10, 0–100. Sensitivity 2000V. 24 range, diameter 133 by 93 by 46mm including test leads. Price **£7·00** plus 50p P. & P. (**£8·10** inc.VAT & P.)

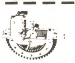
METERS (New) – 90 mm DIAMETER

A.C. Amp., Type 62T2. 0-1A, 0-5A., 0-15A., 0-20A.
A.C. Volt. 0-15V., 0-300V.
D.C. Amp., Type 65C5. 0-2A., 0-10A., 0-20A.,
D.C. Volt. 0-15V., 0-30V.
All types **£3.50 ea.** + P. & P. 50p (**£4.32 incl VAT), except** 0-100A. D.C., price **£5·00** + 50p. P. & P. (**£5·94** incl. VAT).



NEW HEAVY DUTY SOLENOID. mfg. by Magnetic Devices. 240V a.c. operation approx. 10lbs pull at 1·25in. Price **£4·00** P. & P. 60p. (**£4·96** inc. VAT & P.). N.M.S.

MINIATURE UNISELECTOR



12 volt 11-way, 4 bank (3 non-bridging, 1 homing), **£2·50.**
P. & P. 35p (**£3·08** inc. VAT & P.).

600 WATT DIMMER SWITCH

Easily fitted. Fully guaranteed by makers. Will control up to 600W of lighting except fluorescent at mains voltage. Complete with simple instructions **£3·95,** post 25p (**£4·53** inc. VAT & P.). 1,000 watt model **£5·60,** post 25p (**£6·32** inc. VAT & P.). 2,000 watt model **£9·75,** post 40p (**£10·96** inc. VAT & P.).

MICRO SWITCHES

Sub min Honeywell roller m/s type 3115m 906t. 10 for **£2·50** post paid.

LEVER OPERATED 20 amp. C/O. Mfg. by Unimax USA. 10 for **£4,** P. & P. 50p (min. order 10) (**£4·86** inc. VAT).

D.P. C/O lever m/switch mfg. by Cherry Co. USA. Precious metal low resistance contacts. 10 for **£2·25** P. & P. 30p. Total inc. VAT **£3·02** (min. 10).

Sub min lever m/switch type MML 46 10 for **£2·50.** N.M.S.
Post Paid £2.70 inclusive

RESET COUNTER

230V a.c., 3 digits mfg. Veeder Root Type LL 1441 **£1·75.** P. & P. 25p (**£2·16** inc. VAT & P.). 7 Fg 24V d.c. non set **£1·50.** P. & P. 25p (**£1·89** inc. VAT & P.). 6 fig. 24V d.c. resettable **£3.** P. & P. 25p (**£3·51** inc. VAT & P.).
N.M.S.

VORTEX BLOWER AND VACUUM UNIT

Dynamically balanced totally enclosed 9in rotor with max. air delivery of 1·5 cubic metres per min. Max static pressure 600mm W.G. Suction or blow from 2 side-by-side 37mm I.D. circular apertures fitted to base of unit. Powerful continuously rated 115V a.c. motor mounted on alloy base with fixing facilities. Dimensions length 22cm × width 25cm × height 25cm. These units are ex equipment but have had minimum use. Fully tested prior to despatch. Price **£12** + £1·50 P. & P. (**£14·58** inc. VAT & P.)

Suitable transformer for 230/240V a.c. **£6** + £1 P. & P. (**£7·56** inc. VAT & P.)

CENTRIFUGAL BLOWER
Smith type FFB

1606 022 220/240V A.C. Aperture 10 x 4½cm overall size 16 x 14cm. Price **£3·75** P. & P. 75p. (inc. VAT **£4·86**).
Other types available. S.A.E. for details N.M.S.

INSULATION TESTERS *NEW!*

Test to I.E.E. Spec. Rugged metal construction, suitable for bench or field work, constant speed clutch. Size L 8in. W 4in. H 6in weight 6lb, **500V**, 500 megohms, **£49.** Post 80p (**£53·78** inc. VAT & P.). 1,000V 1,000MΩ, **£55.** Post 80p (**£60·26** inc VAT & P.). SAE for leaflet

All Mail Orders—Callers—Ample Parking

Dept. PE, 57 BRIDGMAN ROAD
CHISWICK, LONDON W4 5BB
Phone 01-995 1560

Showroom open Mon.-Fri.

VARIABLE VOLTAGE TRANSFORMERS

INPUT 230/240V a.c. 50/60 OUTPUT
VARIABLE 0–260V All Types
SHROUDED TYPE

200 watt (1 amp inc, a.c. voltmeter	£14.50
0.5 KVA (2½ amp (MAX)	£17.00
.1 KVA (5 amp MAX)	£22.50
.2 KVA (10 amp MAX)	£37.00
.3 KVA (15 amp MAX)	£45.50
.5 KVA (25 amp MAX)	£74.00
10 KVA (50 amp MAX)	£168.00
15 KVA (75 amp MAX)	£260.00

CARRIAGE AND PACKING EXTRA

LT TRANSFORMERS

0–10–15V at 3 amp (ex new equip) **£2·50** P. & P. 50p (**£3·24** inc. VAT)
13–0–13V at 1 amp **£2·50** P. & P. 50p (**£3·24** inc VAT)
25–0–25V at 2½ amp **£4·50** P. & P. 75p (**£5·67** inc VAT & P.)
0-4V/6V/24V/32V at 12 amp **£15·00** P. & P. £1·50 (**£17·82** inc VAT & P.)
0–6V/12V at 20 amp **£13·50** P. & P. £1·50 (inc VAT **£16·20**)
0–12V at 20 amp or 0–24V at 10 amp **£12·00** P. & P. £1·50 (**£14·58** inc VAT & P.)
0–6V/12V at 10 amp **£8·25** P. & P. £1·25 (inc VAT **£10·26**)
0–6V/12V/17V/18V/20V at 20 amp **£16·50** P. & P. £1·.50 (**£19·44** inc VAT & P.)
0–10V/17V/18V at 10 amp **£10·00** P. & P. £1·40 (inc VAT **£12·31**)
Other types in stock; phone for enquiries or send sae for leaflet.

STROBE! STROBE! STROBE!

HY-LIGHT STROBE KIT MK IV

Latest type Xenon white light flash tube. Solid state timing and triggering circuit 230/240V a.c. operation. Designed for larger rooms, halls, etc. Speed adjustable 1–20 f.p.s. Light output greater than many (so called 4 Joule) strobes. Price **£19·00.** Post £1 (**£21·60** incl. VAT & P.). Specially designed case and reflector for Hy-Light **£8·80.** Post £1 (**£10·58** inc. VAT & P.).

XENON FLASHGUN TUBES

Range available from stock
S.A.E. for details

ULTRA VIOLET BLACK LIGHT FLUORESCENT TUBES

4ft. 40 watt £7.75 (callers only) **2ft. 20 watt £5.50.** Post 60p (For use in start bi-pin fittings) **Mini 12in. 5 watt £2.50.** Post 25p (**£2.97** inc VAT & P) **9in 5watt £2.00** Post 25p (**£2.43** inc VAT & P) **6in 4 watt £1.75** Post 25p (**£2.18** inc VAT & P) Complete ballast unit Either 6" 9" or 12" tube 230V AC op **£3.50** plus P & P 40p (**£4.21** inc VAT & P) Also available for 12V DC op **£3.50** plus P & P 40p (**£4.21** inc VAT & P)

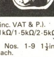
SQUAD LIGHT

A new conception in light control. Four channels each capable of handling 750 watts of spotlights, floodlights or dozens of small mains lamps. Seven programs all speed controlled plus flash modulation, effectively giving 14 different displays. Makes sound-to-light obsolete. Completely electrically and mechanically noise free.

Price only **£60·00**

Post 75p. S.A.E. (Foolscap) for further details.

Superior Quality Precision Made NEW POWER RHEOSTATS



New ceramic construction, vitreous enamel embedded winding heavy duty brush assembly, continuously rated.
25 WATT 10/25/50/100/150/250/500/1kΩ/1·5kΩ, **£2·40.** Post 20p (**£2·81** inc. VAT & P.).
50 WATT 100/250Ω **£2·90.** Post 25p (**£3·40** inc. VAT & P.).
100 WATT 1/5/10/25/50/100/250/500/1kΩ/1·5kΩ/2·5kΩ/3.5kΩ **£5·90** p & p 35p (**£6·75** inc VAT).
Black, Silver, Skirted knob calibrated in Nos. 1-9 1½in. dia. brass bush. Ideal for above Rheostats **24p** each.

RELAYS

Wide range of AC and DC relays available from stock. Phone or write in your enquiries.

230/240V A.C. Relays: Arrow 2 c/o. 15 amp **£1.50** (**£1.84** inc. VAT & P).
T.E.C. open type 3 c/o. 10 amp **£1.10** (**£1.40** inc. VAT & P).
Omoron or Keyswitch 1 c/o. 7 amp **£1.00** (**£1.30** inc. VAT & P).
D.C. Relays: Open type 9/12V 3 c/o 7 amp **£1.00** (**£1.30** inc. VAT & P). Sealed 12V 1 c/o 7 amp octal base. **£1.00** (**£1.30** inc. VAT & P). Sealed 12V 2 c/o 7 amp octal base. **£1.25** (**£1.56** inc. VAT & P). Sealed 12V 3 c/o 7 amp 11-pin. **£1.35** (**£1.67** inc. VAT & P). 24V. Sealed 3 c/o 7 amp 11-pin **£1.35** (**£1.67** inc. VAT & P). (amps = contact rating). P&P on any Relay 20p.
Other types available — phone for details. N.M.S.

N.M.S.

Diamond H heavy duty A.C. relay 230/240V a.c., two C/O contacts 25 amps res at 250 a.c. **£2.50** p&p 50p. (£3.24 inc VAT + p&p) Special base **50p.**

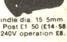
VAT

AT CURRENT RATE MUST BE ADDED TO ALL ORDERS FOR THE TOTAL VALUE OF GOODS INCLUDING POSTAGE UNLESS OTHERWISE STATED

SERVICE TRADING CO.

ACCOUNT CUSTOMERS MIN. ORDER £10·00

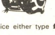
GEARED MOTORS



100 r.p.m. 115lb.in. 110V. 50Hz. 2·8A. single phase split capacitor motor. Immense power. Continuously rated. Totally enclosed. Fan cooled in-line gearbox. Length 250mm. Dia. 135mm. Spindle dia. 15·5mm. Length 145mm. Ex-equipment tested **£12.** Post £1·50 (**£14·58** inc. VAT & P.). Suitable transformer 230/240V operation **£8.** Post 75p (**£9·45** inc. VAT & P.).

N.M.S.

GEARED MOTORS

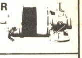


28 r.p.m. 20 lbs inch
115v a.c. Reversible motor.
71 r.p.m. 10 lbs inch
115v. a.c. Reversible motor.

Both types similar to above drawing. Price either type **£4·75** p&p 75p. (£5·94 inc VAT + p&p)
Supplied complete with transformer for 240v a.c. operation **£7·25** p&p £1·00 (£8·91 inc VAT + p&p)

Crouzet 230/240V. AC **2RPM** synchronous geared motor. Brand new **£2·90** p&p 30p. (£3·45 incl VAT) (quantity discount available.)

FRACMO GEARED MOTOR



56 r.p.m., 50lb.in. 240V a.c. 50Hz, 0·7 amp. sharplength 35mm, dia. 16mm, weight 6 kilos 600 grammes. Price **£15·00** P. & P. £1·50 (£17·82).
N.M.S.

PARVALUX GEARED MOTOR

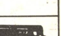
230/240V A.C. **30 rpm 50lbs** inch. Price **£15·00** P. & P. £1·00 (**£17·82** inc. VAT).

N.M.S.

PARVALUX GEARED MOTOR

230/250V a.c. 500 rpm, 3½lbs inch. 2 right angled spindles **£11.00** P & P £1.00 (**£12.96** inc. VAT & P.).
N.M.S.

CITENCO 19 RPM



FHP motor type C 7333/15 220/240V a.c. 19 r.p.m. reversible motor, torque 14·5 kg. gear ratio 144–1. Brand new incl. capacitors, our price **£14·25.** P. & P. £1·25 (**£16·20** inc. VAT & P.).
N.M.S.

PROGRAMME TIMERS

12 cam model **£7·50.** Post 60p (**£8·75** inc. VAT & P.). Also available for 50V operation. Price as above.
N.M.S.

Time Switch

Venner Type ERD Time switch 200/250V a.c. 30 amp contact 2 on/2 off every 24 hrs. at any manually pre-set time. 36 hour Spring Reserve and day omitting device. Built to highest Electricity Board specification. Price **£7·75.** P. & P. 75p (**£9·18**).
R. & T.

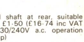
SANGAMO WESTON TIME SWITCH

Type S251 200/250V. a.c. 2 on/2 off every 24 hours. 20 amps contacts with override switch dia. 4 x 3 price **£6·50** P. & P. 50p inc. VAT **£7·56**. Also available with Solar dial.
R. & T.

FRACMO MOTOR

1400 rpm H.P. 1/30 continuously rated 115V a.c., supplied complete with transformer for 230/240V a.c. op. Complete with anti vibration cradle mounting **£10·00** P. & P. £1·00 (**£11·88** inc. VAT & P.). N.M.S.

ROTARY VACUUM AIR COMPRESSOR & PUMP



Carbon vana oil free vacuum pump and compressor. Approx 20 inch vacuum 10 PSI at .79 CFM
Powered by 110V a.c. 1.8 amp
Parvalux motor fitted with additional shaft at rear, suitable light loads. Inc. capacitor **£14·00** p&p £1·50 (£16·74 inc VAT + p&p) Suitable transformer for 230/240V a.c. operation **£5·00** p&p £1·00 (£6·48 inc VAT + p&p)
N.M.S.

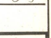
Yet another outstanding offer.

New IMFD 600V Dubilier wire ended capacitors, 10 for **£1·50** p&p 50p. (£2·16 inc VAT + p&p) (Min 10)

WIDE RANGE OF DISCO LIGHTING EQUIPMENT

S.A.E. (foolscap) for details.

230V a.c. FAN ASSEMBLY.



Powerful continuously rated a.c. motor complete with 5 blade 6½in. Aluminium fan. Price **£3·00.** P. & P. 65p (**£3·94**). N.M.S.

KEY:
N.M.S. New Manufacturers Surplus
R. & T. Reconditioned and Tested

Personal callers only Open Saturdays

9 LITTLE NEWPORT STREET
LONDON WC2H 7JJ
Phone 01-437 0576

KITS! * KITS! * KITS!

You must try our fabulous new range of 'ELEKITS' for an easy build introduction to electronics. All kits, and there are many to choose from, come complete with case, easy to follow instructions and **ALL COMPONENTS**. Battery powered (not supplied) for safety and economy — ELEKITS will give hours of enjoyment — learning as you build. A small selection from the 'ELEKIT' range is shown below.

ACE MAILTRONIX LTD
Dept. **PE**, Tootal Street
Wakefield, W. Yorkshire WF1 5JR

Watch this space for future kits!

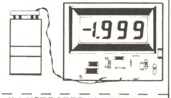
NEW
FABULOUS
'ELEKITS'
FOR **FREE** BROCHURE
SEND S.A.E.

ALL KIT PRICES INCLUDE V.A.T

COMPONENTS

The ACE 2nd edition illustrated catalogue shows a considerably enlarged range of components, modules, 'Elekits'. Many PRICE REDUCTIONS from edition one. Component range includes — CAPACITORS, HARDWARE, CASES, LED's, VERO PRODUCTS, RESISTORS, RS COMPONENTS, TRANSISTORS, DIODES, SCR's, IC's (Linear, TTL, CMOS, Audio), SWITCHES, PLUG/SOCKETS, BOOKS, TRANSFORMERS, TOOLS, SPEAKERS AND TEST EQUIPMENT. Typical VAT inclusive prices:—

LED's RED	**15p**
LED's GREEN	**25p**
8-pin IC SKT	**15p**
AC126	**20p**
AC128	**27p**
BC107/8/9	**13p**
BC177/8/9	**19p**
BC182/3/4L	**11p**
BC212/3/4L	**11p**
BC547/8/9	**13p**
BC557/8/9	**15p**
BCY70/71	**20p**
BFY50/1/2	**23p**
OC71	**16p**
TIS43	**35p**
ZTX107/8/9	**14p**
2N2926G	**13p**
2N3055	**54p**
2N3702/3/4/5	**11p**
2N3819	**24p**
OA90/91	**7p**
IN4148	**4p**
IN4001	**5p**
WO4	**25p**
Zener BZY88	**12p**
741 8-pin	**22p**
555	**35p**
4001	**20p**
7400	**15p**
7490	**62p**
Push sw.	**16p**
Slide toggle	**19p**
W/C switches	**54p**
O.25 CF Res.	**6p per 3**



MODULES
Ready built.
Power supplies 1, 2 and 3 rail,
Fixed and variable.
DPM's 3½ digit. LED and LCD
Count/display 4 and 6 digit.

SEND 30p FOR THE ACE ILLUSTRATED CATALOGUE WHICH INCLUDES FULL LIST OF COMPONENTS, KITS AND READY-MADE MODULES. 30p REFUNDED WITH FIRST ORDER OF £5 OR MORE.

NAME ______________________

ADDRESS ______________________

Connoisseur's SAU 2 Lightweight Metal Head Shell

A new development for more efficient tracking and adjustment, and more attractive appearance, the new lightweight metal head shell is perfectly interchangeable for existing SAU2, BD2 and BD103 pick up arms.

Connoisseur

Write for further details to:
A. R. Sugden & Co. (Engineers) Ltd.
Manufacturers of Connoisseur Sound Equipment,
Connoisseur Works, Atlas Mill Road,
Brighouse, West Yorkshire HD6 1ES
Telephone: Brighouse (0484) 712142, Telex: 517144 Sugden G
Telegrams & Cables: Connoisseur Brighouse.

NO DISCO SYSTEM IS COMPLETE WITHOUT...

Price when new £39.00
OUR PRICE ONLY **£16.20**
(P&P £1.00 each) *Please note: ropelight kits are available only by Mail Order.*

ROPELIGHTS Ropelight kits now available from Roger Squire's — 22 feet long, 4 channel, including Tube, Bulbs and Multipin connectors. These ropelights are ex-demonstration stock and will require some bulb replacement — we will supply 20 spare bulbs free with your kit. Additional sets of 20 bulbs cost £4.86 each.

PIEZO HORNS
FANTASTIC SPECIAL OFFER TO READERS OF PRACTICAL ELECTRONICS
Tweeters for your disco, PA system or Hi-Fi, Frequency range 5K-20K. No X over required. They can be used in any PA system up to 100W. Why pay more?
OUR PRICE ONLY **£4.99** each (P&P 35p each)

BULGIN OCTAL PLUGS AND SOCKETS
There's always hundreds of Bulgin Octal multiway plugs and sockets in stock at Roger Squire's. Each pin rated 6A. Perfect for your Sound to Light System. P552 SOCKET **£0.65** (P&P 35p) P551 PLUG **£1.84** (P&P 35p) Carriage on 10 or more nominal £1.00 Also available 6-way multicore cable (6 Amps per core) ex stock. £0.65 per metre. Please phone for carriage quote.

PROJECTORS
SQUIRE MULTIFECT 150
— including rotator and effects wheel. A truly versatile projector which uses a powerful 150W Tungsten bulb, all effects attachments simply slot in ready for use.
A BARGAIN AT £40.50 (P&P £1.00)

SOLAR 250
Utilising a 250W Quartz-Iodine bulb giving brilliant light output, this projector is fan-cooled and can be used free standing or ceiling mounted. Dual effect system for stunning versatility. Rotators are extra. Huge choice of special effects and attachments!' **NOW ONLY £70.20** (P&P £2.00)

PLUS MANY DISCO ACCESSORIES
All Roger Squire's shops have a service department which carries large stocks of DISCO SPARES & ACCESSORIES. For example: Fane and H/H Disco Speakers 12" and 15" BSR and Garrard decks at discount prices.

Plus sockets, Fuses, Plugs, etc etc.

Roger Squire's DISCO GEAR

Send Mail Orders to: Roger Squire's Mail Orders, Barnet Trading Estate, Park Road, Barnet, Herts. EN5 5SA.
01-441 3527 (Hotline) 01-441 1919 (Switchboard) Open: Mon-Fri, 9-5.30.

Personal callers: ROGER SQUIRE'S DISCO CENTRES
LONDON: 176 Junction Road, Tufnell Park, N19 5QQ. 01-272 7474
BRISTOL: 125 Church Road, Redfield, Bristol BS5 9JR. 0272 550550
MANCHESTER: 251 Deansgate, Manchester M3 4EN. 061-831 7676

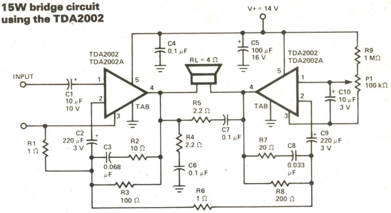
Open from 10-5 Tues-Sat
10-8 Weds.
Closed Mondays.

Semiconductor UPDATE...

FEATURING : TDA2002 TDA 1083 HSCH1001

R. W. Coles

15W bridge circuit using the TDA2002



BRICK OUTHOUSE

The first integrated circuit I managed to lay my hands on, way back in 1966 I think, was an audio amplifier device from R.C.A. By today's standards, that pioneering miracle would be a joke, needing transformers on the input and output and delivering only about 250mW, but to me at the time it was pure magic!

Apart from the fact that you could hardly see the i.c. for its supporting "cast-of-thousands", the thing which eventually disappointed me the most about it was its short life.

Yes, you guessed it, whilst trying my precious miracle in one of a variety of data sheet applications circuits there was a wisp of smoke—then silence.

Now all that is behind me. We have become accustomed to the blow out proof, short circuit proof devices which the wise chip designers provide for us.

Or have we? I still see *myself* as the arch enemy of the audio amplifier chip, blow-out proof or not, and wisps of smoke are by no means unknown on my breadboard socket!

With this sort of background, then, I am always interested in the latest "built-like-a-brick-outhouse" claim for a new audio amplifier chip. Take the **TDA2002** device from Fairchild for example, a much more difficult nut to crack than any I have come across lately.

It comes in a tiny five pin plastic power-tab package and yet boasts an output power of 8W with loads down to 1·6 ohm and output currents of up to 3·5A.

The thing that makes the TDA2002 such a worthy adversary is its long list of fiendish protective measures, Thermal Shutdown, Short Circuit Protection *and* Overvoltage Protection, not bad for a chip which boasts a typical T.H.D. of 0·2 per cent at 5W.

This apparent challenge to my reputation will not go unanswered however. I am already burnishing the tip of my soldering iron in anticipation.

Oh, and by the way Fairchild, I am into lightning-strikes at the moment!

SNUFF TIN SPECIAL

If there is *any* electronic subject likely to raise a yawn from our readers, it must surely be the prospect of an "even smaller" pocket broadcast receiver of the type I like to call squawk boxes! I must confess to having entered the electronics fraternity via the crystal set, the two valve t.r.f (ask your dad!) and the "ham-band-special", before ever discovering the delights of op-amps or logic gates, but even so, the suggestion of *yet another* advance in radio receiver miniaturisation, did not exactly have me choking on my breakfast cornflakes!

Not that I wouldn't have been keen 15 years ago mind you (as a lad, I once built a transistor set in a snuff tin) but our oriental cousins have had the whole thing so well tied up for so long now, that even before the introduction of integrated circuits, all the stuffing *(should this be snuffing?—ed)* had been knocked out of the subject as far as I was concerned. If I have *any* yen (sic) at all for broadcast receivers nowadays, it's for the antique variety with rows of fat glowing valves, solid mahogany cabinets, and the vain hope that one day whilst tuning through "Hilversum" or "Athens" I might just detect an eerie "Germany calling-Germany calling!"

But enough of my life story. The new development I am about to update you with, is, believe it or not, of the very sort to which I have just been objecting. The reason it appears at all, is because I consider it a development so final in its scope, that I confess to feeling a twinge of the old "snuff tin excitement", and if you can stifle your yawns long enough, I think you might agree with me.

The device is an integrated circuit from Sprague, coded ULN 2204A by its American maker, but already boasting a European Proelectron code of **TDA 1083.** Quite simply this new chip is a complete radio receiver in a sixteen pin dual in line package. Complete, because it contains an a.m. front end, an i.f. amplifier, an a.m. and f.m detector stage, an audio amplifier and a power supply regulator.

True, it does *not* boast a loudspeaker, and you *do* still need a couple of r.f. coil cans and a capacitor or two, but until we switch to telepathic broadcasting, it's about as integrated as a radio receiver can get.

You can't even fault it on its performance. It is a full superhet with a.g.c. facilities, and has a 20 microvolt sensitivity for full output on a.m. When used in a dual mode receiver, a.m./f.m. switching is all carried out at d.c. so you could use a D.P.S.T. toggle switch if you wanted to. The audio amplifier, depending on supply voltage (the dip works on 2 to 12 volts, or much higher voltages with a single external resistor) will provide up to a watt into an 8 ohm speaker.

It's true that my snuff tin special needed an earphone and about 200 feet of aerial for correct operation, but how can mere technology replace it?

BARRIERS DOWN

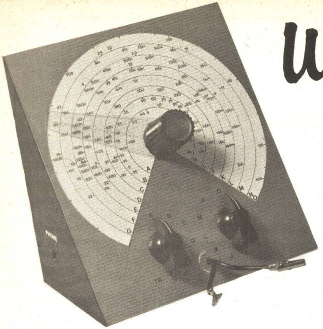
Still using germanium diodes in low forward voltage applications such as r.f. detector circuits and logic clamps? Do yourself a favour and try a Shottky barrier diode instead.

Shottky barrier diodes have a forward drop of only about 400mV at 1mA and have low capacitance and pico-second switching speeds to match. Hewlett Packard have now introduced a low cost S.B.D. in a common or garden DO35 package, coded **HSCH1001.**

Apart from the usual advantages of S.B.D.s, the new device features a 60V reverse breakdown voltage, and only a 200nA leakage at 50V.

Wide Range C/R BRIDGE

W.ENGLISH



THIS CR bridge is a wide range instrument capable of measuring resistance values from 0·5Ω to 20MΩ and capacitance values from 0 to 1,000μF. The unit has 15 ranges (seven resistance and eight capacitance) which are arranged as follows:

Range		Range	
A	0·5Ω–20Ω	H	0–100pF
B	3·3Ω–180Ω	I	75pF–1,000pF
C	33Ω–1·8kΩ	J	800pF–0·01μF
D	470Ω–18kΩ	K	7nF–0·1μF
E	3·9kΩ–180kΩ	L	75nF–1μF
F	33kΩ–2MΩ	M	0·75μF–22μF
G	1MΩ–20MΩ	N	8μF–100μF
		O	100μF–1,000μF

The certain amount of duplication that appears is an advantage when balancing the bridge, because it allows the most open part of the scale to be selected.

CIRCUIT DESCRIPTION

The circuit diagram of the CR bridge is shown in Fig. 1. It is energised by an AF oscillator housed in a separated case and its balance or null point is detected by using a crystal earphone.

When a resistor is placed in the test clips it forms a bridge circuit with VR1, R8 and one of the resistors R1–R7 (according to the position of S1).

If a capacitor is to be measured S1 should be switched to the TR position which transfers the circuits through to the capacitor range and the bridge then balanced using VR1 and S2. When measuring the value of electrolytic capacitors it will be necessary to "bias" these with the appropriate voltage.

CONSTRUCTION

The components for the bridge are mounted on a 18 s.w.g. aluminium panel 150 × 130mm, which is fitted to two wooden side pieces so the front panel is inclined at an angle of 60 degrees.

The resistors and capacitors should be mounted on the two 12-way wafer switches as shown in the photograph before the switches are mounted onto the front panel. The free ends of the components are connected to a bus-bar across the two switches and the leads for the test clips are passed through a grommet on the front panel and have two small crocodile clips connected to them.

The scaleplate should be marked out as shown in the photograph; no component values should be marked on the scale plate until the calibration stage. The cursor consists of a piece of thin perspex sheet scribed with a centre line which is drilled so that the holes correspond with the lines on the scaleplate, enabling accurate calibration. The cursor is then fixed to a suitable knob.

AF OSCILLATOR

The circuit diagram of the AF oscillator is shown in Fig. 2. The unit consists of an astable multivibrator formed by TR1 and TR2 with TR3 used as an output amplifier stage. VR2

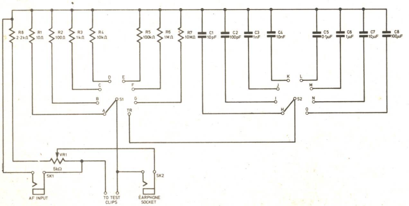
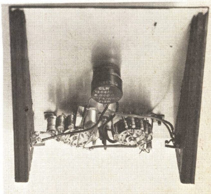


Fig. 1. **Complete circuit diagram of the CR Bridge**



Rear view of CR Bridge

COMPONENTS . . .

Resistors

R1	10Ω
R2	100Ω (2 off)
R3	1kΩ
R4	10kΩ
R5	100kΩ
R6	1MΩ
R7	10MΩ
R8	2·2kΩ 10% carbon
R9, R12	7·5kΩ (2 off)
R10, R11, R13	120kΩ (3 off)
R14	1kΩ $\frac{1}{8}$W 5%

All 1% $\frac{1}{4}$W unless otherwise stated

Potentiometers

VR1	5kΩ wirewound
VR2	25kΩ linear

Capacitors

C1	10pF
C2	100pF
C3	1,000pF
C4	10nF
C5	0·1µF
C6	1µF 16V tant
C7	10µF 16V tant
C8	100µF 16V tant
C9, C10	0·01µF C280 (2 off)
C11, C12	47µF tant 16V (2 off)

All 2% polystyrene unless otherwise stated

Semiconductors

TR1, TR2, TR3	BC113 (3 off)

Miscellaneous

3 off 3·5mm jack plugs and sockets
2 off 1 pole 12-way wafer switch
2 off pointer knobs
2 off crocodile clips
1 off PP3 battery
battery clips (if req)
crystal earphone

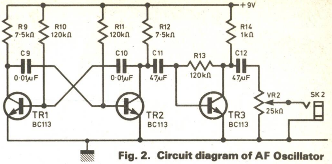


Fig. 2. Circuit diagram of AF Oscillator

Fig. 3. Printed circuit board design for the AF Oscillator

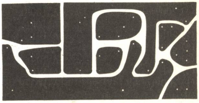
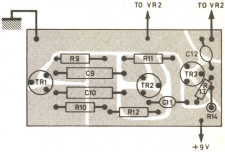
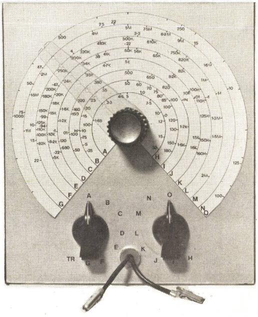


Fig. 4. Component layout for AF Oscillator





enables the output of the oscillator to be adjusted as required.

The prototype unit was constructed using the printed circuit board layout shown in Fig. 3 with the component overlay shown in Fig. 4. The unit which is connected to the bridge via 3·5mm jack plugs and sockets uses a screened lead and is powered by a PP3 battery.

CALIBRATION

After the unit has been assembled and checked the earphone should be plugged in and the AF generator connected and switched on. VR1 should be adjusted for maximum output and then VR2 adjusted so the output to the earphone is not excessive.

To calibrate the unit a wide range of close tolerance components are required. Starting at range A the upper and lower limits of each range should be marked on the scaleplate by uitable value resistors in the test clips and adjusting VR1 until the bridge balances (when the output to the earphone is at minimum). The rest of the values can then be filled in. The null will not be so well defined on the higher ranges but the linear markings around the outside of the scale should make it easier to judge the effective null point. The capacitance ranges should be calibrated using the same method. The lettering on the scale is arranged so that the range letter is at the minimum end of the range. Resistor values increase clockwise and capacitor values anticlockwise. ★

News Briefs

by Mike Abbott

DATA ENCRYPTION UNIT

I'M SURE many readers will have been struggling for some time now, to get to grips with the bytes and bits of machine code and computer programs. Well, you've arrived just in time to be left behind again, because data encryption is here. Actually, this development shouldn't worry you unless you intend to tap confidential data lines for illicit purposes. A less impressive name for Intel's Data Encryption Unit would be data scrambler/unscrambler, and it is intended as a processing peripheral chip which prohibits "listening in" to confidential information in data form which is communicated using land lines.

Applications that immediately spring to mind are in inter-bank communication, military communications and inter-company confidential reports. The American National Bureau of Standards (NBS) have defined a Federal Information Data Encryption Standard, and Intel's new integrated circuit codes and decodes data in accordance with the NBS standard. The new chip, known as the 8294 Data Encryption Unit, has been approved by NBS.

The 8294 codes and decodes 64-bit blocks of data in accordance with a 56-bit user specified key (algorithm) to produce 64-bit cipher words. It is necessary to use the same key for both coding and decoding to produce intelligible information at the receiving end. This means that $2^{56}-1$ ways of encoding the data are provided. In other words, even with the services of a large and very fast computer, it would be virtually impossible for an unauthorised person to hit upon the right key.

The 8294 is designed to act as a peripheral chip in a processing system. The 56-bit key and the 64-bit message are transferred to the 8294 over the system data bus a byte at a time. A DMA interface and three interrupt outputs are available to minimise the software overhead associated with data transfer. With a DMA interface two or more 8294s may be used in parallel to achieve effective conversion rates which are virtually any multiple of 80 bytes per second. As a bonus, the 8294 has a general-purpose seven-bit TTL output port for user specified functions.

The 8294 operates from a 5V ± 10 per cent power supply and is based in a standard 40-pin package.

STATESIDE SCENE

I HAVE been fortunate this year that my work has taken me to New York on a couple of occasions. This has enabled me to take a quick look at the electronics hobby scene on the other side of the pond. To an outsider the market place seems to be dominated by Citizens Band radio and computers.

C.B.

The Citizens Band consists of a group of 40 channels around 27MHz set aside for private low power communication. Any U.S. national can apply for a licence and there is no test to pass. The equipment used usually runs about four watts on a.m., although s.s.b. is creeping in, and it is designed to be idiot proof. There are no tuning controls to set up, you just turn the knob to the required channel, adjust the volume as desired and press the button on the mike to speak.

Homebrew rigs are frowned upon, as are linear amplifiers. Prices range from just under 40 dollars for a mobile rig for the car to several hundred dollars for a microprocessor controlled, keyboard entry, band scanning, base station.

The system may have some faults, with a few million rigs in service there is bound to be some abuse, but it has a lot going for it too. It provides communication between home and the car and enables you to get traffic reports and directions from other drivers. It is reassuring to see a sign beside the road saying *"Nassau police monitor channel xx"*, allowing you to call for help in case of accident or emergency. The coastguard have also started to monitor one of the channels allowing small C.B. equipped boats to call for help in an emergency.

COMPUTERS

As far as home computers are concerned it seems to be a sellers market; they are selling like hot cakes. The demand is for machines with high level language with a good size memory, cassette recorder and/or floppy disc. When you consider that electronics prices in the U.S. are about half these over here and salaries over there are about three times ours, this gives the computer enthusiast in the States a 6–1 advantage over us in purchasing equipment. This means he can afford to skip the switch and l.e.d. machines and buy or build from a kit a relatively powerful machine.

For the kit builder the local Heathkit showrooms had the H8 and Heath/Dec 11 machines on display. The local computer shops stock various S100 bus compatible p.c.b. kits for memory, I/O, etc. and numerous mail order firms offer boards and card frames for this bus. There are various ready to use machines available via the computer shops and a bewildering array of books on software to get you started programming.

One machine that seems to be going to lead the field is the TRS80, retailed by the Radio Shack shops. The Radio Shack shops are not as their name might suggest ham radio shops, they sell hi-fi units, C.B. transceivers, car radios, tape players, etc. and now the TRS80 computer. As there are Radio Shack shops everywhere and each one seems to have one TRS80 in the window and a demonstration model inside, sheer weight of numbers should help the machine fight its way to the front. It also seems to be a rather nice machine *(The TRS80 is available from Tandy in the U.K.—Ed)*

It has the Z80 C.P.U., level 1 basic in 4K ROM, and 4K RAM. Level II basic and 16K RAM are available as an option, and there are printers, floppy discs, etc. available to order.

The computer section seems to be well served by magazines such as Kilobaud, Byte and Interface Age, etc. and there appears to be a thriving market in software offerings for the more popular machines, cassettes being available with games and maths programs from numerous sources.

RACING CARS

One interesting offering in the hobby shops was a radio controlled electric racing car with a single chip microprocessor in the transmitter and another one in the car. The method of encoding allows four cars to be raced together although the receivers in the cars are simple superregen types. The frequency band it operates in is around 50MHz but it should be possible to use the sets at 27MHz with suitable mods. to the r.f. side.

I was lucky enough to visit a small exhibition put on by the Long Island Mobile Amateur Radio Club. The club is very active and they operate five repeaters on v.h.f. and above, one of them for TV. They put on quite a good show, with a couple of 2 metre stations, RTTY and slow scan using the ROBOT slow/fast scan convertor. Apparently repeaters are very thick on the ground in the area. I was told that there were 200 within a 70 mile radius of the Empire State building. This gives good coverage but interference between repeaters must be a problem!

Dave Coutts

ELECTROVALUE Buying Guide

Section 3

Meet us at
BREADBOARD 78
Stand B.8. Nov 25-28.

If you have bought before from Electrovalue, you will know just how large and varied our stocks are. For those who have yet to know, we are publishing a series of five ads. month by month to give up-to-date information and prices on the most important items we carry. These ads. will appear in stepped rotation in five journals – Pr. Wireless, Pr. Electronics, Everyday Electronics, Electronics Today Intntnl. and Elektor, so that the complete series will be available each month. In this way, no matter which journals you read, BY DETACHING AND SAVING THESE PAGES, YOU WILL BUILD UP A VALUABLE, COMPREHENSIVE AND UP-TO-DATE MONEY SAVING CATALOGUE.

I.Cs/Opto/Displays

INTEGRATED CIRCUITS

TTL 7400 series

7400	14p
7401	14p
7402	14p
7403	14p
7404	18p
7405	14p
7407	22p
7408	18p
7409	18p
7410	14p
7413	22p
7414	60p
7420	14p
7430	14p
7440	14p
7442	54p
7443	60p
7444	60p
7447	70p
7450	14p
7451	14p
7453	14p
7454	14p
7460	14p
7470	24p
7472	24p
7473	23p
7474	23p
7475	45p
7476	32p
7480	41p
7482	61p
7483	58p
7485	74p
7486	27p
7490	40p
7491	71p
7492	46p
7493	40p
7494	66p
7495	57p
7496	63p
74100	73p
74104	40p
74107	27p
74121	27p
74123	51p
74141	54p
74151	60p
74154	1·07
74190	94p
74191	94p
74192	94p
74193	94p

CMOS (All buffered and protected types)

4000	19p
4001	19p
4002	19p
4006	96p
4007	19p
4008	80p
4009	54p
4010	54p
4011	19p
4012	19p
4013	40p
4014	96p
4015	1·14
4016	40p
4017	80p
4018	88p
4019	64p
4020	96p
4021	88p
4022	83p
4023	19p
4024	90p
4025	19p
4026	1·75
4027	58p
4028	95p
4029	1·23
4030	54p
4041	84p
4042	80p
4043	93p
4044	93p
4046	1·28
4049	48p
4050	48p
4060	1·33
4069	19p
4070	19p
4071	19p
4072	19p
4081	19p
4082	19p
4510	1·28
4511	1·36
4514	3·30
4516	1·37
4518	1·25
4520	1·25
4543	1·30
4583	1·28

I.C.s of alternative manufacture may be supplied

709C5	42p
709C14	42p
723C5	52p
723C14	52p
741C5	45p
741C8	27p
741C14	40p
748C8	45p
7107	£13·60N
7805	99p
7812	99p
7815	99p
7905	1·65
7912	1·65
7915	1·65
CA3130	99p
CA3140	40p
LM301AN	30p
LM308N	60p
LM380N	99p
LM3900N	99p
NE555V	32p
NE556A	76p
S041E	2·69
S041P	1·15
S042E	3·45
S042P	1·30
S566B	4·57
SAJ131	2·38
SAJ141	2·00
SAJ205	4·10
SAJ410	1·05
SAS201A	2·08
SAS211A	2·08
SAS560	2·14
SAS570	2·14
SAS580	2·22
SAS590	2·22
SN76013N	1·50
SN76013ND	1·66
SN76023N	1·81
SN76033	£1·50
SN76033N	1·50
SN76023ND	1·66
TAA761A	49p
TAA861A	47p
TAA865A	58p
TAA2761A	70p
TAA4761A	1·04
TBA120S	67p
TBA400	1·84
TBA800	97p
TBA810	97p
TBA820	97p
TBB0747A	62p
TBB1458B	62p
TCA105	1·25
TCA311A	53p
TCA335A	65p
TCA345A	1·16
TCA780	3·15
TCA965	1·23
UAA170	1·60
UAA180	1·60

OPTO-ELECTRONIC

Photo sensitive diodes

BPW32	2·64
BPW33	4·32
BPW34	1·98
BPX48	3·93
BPX63	2·09
BPX91	2·70

Solar Cells

SC1 0·4V × 22mA	2·40
SC2 0·4V × 80mA	3·15

(*@ 1KW/m²*)

Photo sensitive transistors

BPX81	79p
BPY61/2	3·69
BPY61/3	3·86
BPY62/2	89p
BPY62/3	98p
BP101	85p

Light dependent resistor

MKY7C38E	70p

Light emitting diodes

LD30A red	19p
LD35A yellow	23p
LD37A green	23p
LD41A red*	19p
LD52C red*‡	42p
LD55A yellow*	26p
LD56C yellow*‡	42p
LD57A green*	26p
LD57C green*‡	42p

code * 5·1mm dia not 2·9mm
code ‡ extra-bright

LD242 IR	72p
LD261 IR	94p
LD461 0·1" mat'x	23p
LD468 8 × LD461	2·40
LD471 green 0·1"	32p
LD481 yellow 0·1"	32p
LD488 8 × LD481	2·40

Panel mountings

Large for 5·1mm	3p
Small for 2·9mm	3p

LED Drivers UAA170, UAA180 see ICs.

7-SEGMENT DISPLAYS

common anode

LED 0·3" with LH dec

XAN 3072 red	1·50
XAN 3052 green	1·80
XAN 3082 yellow	1·80

LED 1" with RH dec. pt.

1720 red	2·95N

Incandescent 5V with RH dec. pt.

3015F/BM8, 8mA/seg	2·25
3015F/BM15 15mA/seg	2·25

Incandescent +1 with RH dec. pt.

3015G/BM8, 8mA/seg	2·25

DISPLAY MOUNTING HARDWARE

1750N04 4 × 0·3" digits	4·90N
1750N06 6 × 0·3" digits	7·86N
1752N04 4 × 1" digits	7·30N

OPTO COUPLER

CNY 17	£2·24

LIQUID CRYSTAL DISPLAYS

Field-effect types 4 to 17V rms operation 40-pin DIL package, 1·3" row spacing (IC 4543 suitable for driver) Data sheet available

L914, 3½ digit	£13·75N
L920, 4 digit	£13·15N

POLARISED FILTERS

Circularly polarised to eliminate glare from bright metal parts.

PNF21 2" × 1"	44p
PNF31 3" × 1"	60p
PNF61 6" × 1"	£1·20

BREAD BOARDS

(PB Products)

S-DeC	3·50	T-DeC	4·50
μ-DeC-A	4·65	μ-DeC-B	6·99

Four-pack (4 × S-DeC)	7·50*
DeCstor (2 × S-DeC)	4·29*
PB103 plugs, various colours pack of 10 of 1 colour	45p

EXPERIMENT GUIDES:
(*zero VAT*)

PB121 (basic electricity)	1·50
PB122 (R, C, L, semi's)	1·77
PB123 (Bridges, pot'r ccts)	90p
PB124 (L, C, R & a.c.)	2·40
PB125 (Active circuits)	4·20

I.C. Carriers for T- μ-DeC-A with sockets

DIL	PB062	1·92
10-lead T05	PB072	1·80

Without sockets

DIL	BB061	99p
10-lead T05	BB071	90p

* *Cannot be repeated*

MOTOROLA
Microprocessor
D2. Evaluation Kit
(for the M.680
microcomputer)
£175·87 (N) + V.A.T.

Other sections in this series

SECTION ONE
Transistors and diodes etc.

SECTION TWO
Capacitors of all types

SECTION FOUR
Resistors, Pots, Knobs, etc.

SECTION FIVE
Pot Core selection, Solder Tools, Transformers, etc.

●

Complete price list free on request

●

BOOKS SELECTION

(*ZERO RATED FOR VAT*)

BERNARD BOOKS (*Please order by book number*)

No.	TITLE	
BP1	First Book of Transistor Equivalents & Substitutes	50p
BP4	Worlds Short Med & L.W. FM & TV Stations Listing	60p
BP14	Second Book of Transistor Equivalents	95p
BP15	Constructors Manual of Electronic Circuits for the Home	50p
BP17	Radio Receiver Construction using ICs & Transistors	60p
BP24	52 Projects using the 741	75p
BP25	How to Build your own Quartz controlled watches & clocks	85p
BP27	Giant Chart of Radio & Electronic Semi- & Logic Symbols	60p
BP32	How to Build your own Metal & Treasure Locators	85p
BP39	50 Field-effect Transistor Projects	1·25
BP40	Digital IC Equivalents & Pin Connections	2·50
BP45	Projects in Opto-Electronics	1·25
BP46	Radio Circuits using ICs	1·35
BP48	Electronic Projects for Beginners	1·35
BP50	IC.LM3900 Projects	1·35
BP51	Electronic Music and Creative Tape Recordings	1·25
211	First Book of Diode Characteristics, Equivs & Substitutes	95p
224	50 CMOS IC Projects	95p
223	Fifty Projects using IC.CA3130	95p
BP41	Linear IC Equivalents and Pin Connections	2·75
225	A practical Introduction to Digital ICs	95p
227	Beginners Guide to building Electronic Projects	1·25
228	Essential theory for the Electronic Hobbyist	1·25

and many other titles

FOULSHAM TAB ELECTRONIC BOOKS

100	Basic Math Course for Electronics	1·40
528	Pulse Switching Circuits	1·95
553	Electronics Self-taught with Experiments & Projects	3·95

and many other titles

ANOTHER ELECTROVALUE SPECIAL

We are now National Distributors for

NASCOM 1 MICROCOMPUTER KITS

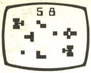
for delivery from stock from
£197·50 net
+ V.A.T.

- ***Quantity discounts***
- ***Trade Enquiries invited***

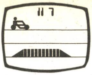
- GOODS SENT POST FREE U.K. WITH C.W.O. orders over £5 list value. If under, add 27p handling charge.
- **ATTRACTIVE DISCOUNTS** on C.W.O. mail orders—**5%** where list value is over £10; **10%** where list value is over £25.
- TOP QUALITY MERCHANDISE—ALL GUARANTEED.
- **V.A.T.**—Add **8%** to value of order. For items marked *, add 12½%.
- For ACCESS or BARCLAYCARD orders, just phone or write your number.
- No discounts allowable on prices marked NET or N.
- TAKE GOOD CARE OF THIS PAGE AND REMEMBER TO LOOK OUT FOR NEXT MONTH'S TO ADD TO IT.
- OUR COMPUTER-AIDED SERVICE TAKES GOOD CARE OF YOUR ORDER NO MATTER HOW LARGE OR SMALL.
- Comprehensive price list free on request.

All communications to Dept. PE.11

ELECTROVALUE LTD
28, ST. JUDES ROAD, ENGLEFIELD GREEN.
EGHAM, SURREY TW20 0HB
Telephone Egham 3603 Telex 264475
Northern Branch - 680, BURNAGE LANE.
BURNAGE, MANCHESTER M19 1NA (061) 432 4945



Tune into Bargain TV Games and Components

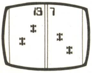


STAND ALONE KITS
Kits – full instructions all PCB components. Minikits – instructions, chip, skt, coil, PCB.

	Kits	Mini-kits
B&W Tank Battle (AY-3-8710)	**£15.90**	**£9.75**
B&W Stunt Rider (AY-3-8765)	**£15.90**	**£9.75**
B&W Road Race (AY-3-8603)	**£14.90**	**£8.50**
B&W 10 Game B/B (AY-3-8610)	**£13.90**	**£8.50**
B&W Submarine (AY-3-8605)	**TBA**	**TBA**
B&W Wipeout (AY-3-8606)	**£14.90**	**£8.50**

MICROPROCESSOR GAMES (full details on request).

Atari VCS (cartridge games)	**£169.95**
Grandstand Fairchild	**£119.00**
Tolinka TV Chess (kit)	**£109.50**



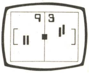
ASTEC MODULATORS & ENCODERS

UM1263 Sound Osc	**£1.95**
UM1111 E36 UHF Mod	**£1.95**
UM1233 UHF (high quality)	**£4.95**
UM1168 Pal Encoder	**£2.50**
UM1163 Pal Enc + UHF Mod	**£4.95**

European Equivalents available

ACCESSORIES

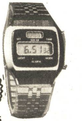
AB Joystick controls 200k lin	**£1.95**
Crystal 4.4 Mhz	**£1.00**
Crystal 3.57 Mhz	**£1.25**
Oscillator coil 100µH	**£0.45**
Mains adaptor + 150mA 8v reg i/c	**£3.50**



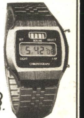
UNBELIEVABLE WATCH BARGAINS

VT01
5 FUNCTION LCD
Hour, Min, Sec, Month, Date, s/s strap, backlight.
ONLY £8.95

VT02
12 FUNCTION/ CHRONOGRAPH
Hour, Min, Sec, Day, Date, Month, $\frac{1}{100}$th sec time 1 or 2 event.
ONLY £13.95



VT03
SOLAR ALARM
Hour, Min, Sec, Month, Date, Day, Alarm any time in 24 hour day.
ONLY £25.95



VT04
SOLAR CHRONO-GRAPH
As VT02 but with solar panel.
ONLY £25.95

VT05
CHRONO-GRAPH/ALARM
All the combined features of alarm + chronograph watches.
ONLY £37.95

VT06
ALARM/STOP WATCH CLOCK
+ Snooze Alarm, Stop Watch.
ONLY £17.95

★Prices include VAT, packing & delivery charges and money back guarantee. Send cheque or P.O. to:

BARCLAYCARD VISA

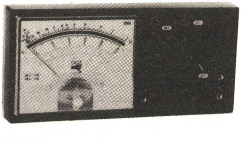
VIDEOTIME PRODUCTS 56 Queens Road, Basingstoke, Hants RG21 1REB
Tel: (0256) 56417. Telex 858747

We welcome Access

(Trade & Export Enquiries welcome)

Doram

SEE THE RANGE OF MULTIMETERS IN THE NEW DORAM HOBBIES CATALOGUE.



Doram Electronics Ltd
PO Box TR8, Leeds LS12 2UF

Please send my FREE Hobbies Catalogue. (AVAILABLE LATE SEPT)

I enclose 25p contribution to p. & p.

Name...

Address...

PE7

....

Doram Doram Electronics Ltd
PO Box TR8, Leeds LS12 2UF

Overseas customers (except for N. Ireland)–**60p** including despatch by Air (or all-up post).

CRESCENT RADIO LTD.

1 ST. MICHAELS TERRACE,
WOOD GREEN, LONDON,
N22 4SJ (MAIL ORDER DEPT.)

01-888 4474

TELESCOPIC AERIAL

8 Section Telescopic Aerial
Length, extended: 96 cm. ($37\frac{3}{4}$")
Length, closed: 16 cm. ($6\frac{1}{4}$")
Nut and bolt fixing at base of aerial.
Only 70p each + $12\frac{1}{2}$% VAT

"FLIP"!

AN ELECTRONIC VERSION OF TWO-UP OR ODDS AND EVENS.
We supply a complete kit of parts which includes a strong case and attractive front panel to give the finished game a long life and professional appearance.
Full assembly instructions are supplied. 'If you can solder you can make this great game.'
An ideal first project to introduce you to electronics.
Not only will 'FLIP' start you on a great hobby but you will own a game which will amuse you and your friends for hours.
Complete Kit: £5.25 + 8% VAT
Post Free!

BARGAIN LOUDSPEAKER

Goodmans 5" 8 ohm long throw heavy duty L/SPKR.
Mounting plate is integral with L/S chassis and has fixing holes with centres spaced at $5\frac{1}{4}$" (diagonally)
Only £5.00 + $12\frac{1}{2}$% VAT.

2 WAY 8 OHM HEAVY DUTY XOVER.

A 2 way 8 ohm H/D Xover suitable for L/S systems up to 100W. Input via screw terminals. Fitted with a 3 position 'HF LEVEL' switch which selects either Flat, –3dB or –6dB.
Buy now while stocks last!
Only £3.00 + 8% VAT.

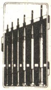
3 KILOWATT PSYCHEDELIC LIGHT CONTROL UNIT

1000W lighting per channel, max.
A 3 channel sound to light unit housed in a robust metal case, with a sensitivity control for each channel i.e. Bass, middle and treble. Full instructions make this unit easy to connect to your present amplifier.
S.A.E. for spec. sheet.
Still only £20.00 + 8% VAT.

POWER SUPPLY UNIT

PP1 – switched 3, $4\frac{1}{2}$, 6, $7\frac{1}{2}$, 9 and 12 volts at 500mA, with on/off switch and pilot light.
Size: 130 × 55 × 75mm approx.
Our Price: £6.00 + 8% VAT

SIX-PIECE MINIATURE SCREWDRIVER SET



Six precision screwdrivers in a hinged plastic box. Blade sizes: 0·8mm, 1·4mm, 2mm, 2·4mm, 2·9mm, 3·8mm.
Our Price: £1.75 + 8% VAT

PIEZO ELECTRIC HORN UNITS

High Quality, High Power Tweeter. No Xover reqd. Freq. Response: 3·8kHz–28kHz. Spec. sheet sent on receipt of S.A.E.
Our Price: £6.50 + 8% VAT.

BARGAIN TRANSFORMER

240V Primary 12—0—12V 500mA sec.
Approx. size: 60 × 40 × 50mm. Fixing centres: 75mm.
Price: £1.50 + 8% VAT.

Access

'P&P' orders up to £5, Add 30p.
Orders £5–£10, Add 50p.
All orders over £10 post free!
Please add V.A.T. as shown.
S.A.E. with all enquiries please.

BARCLAYCARD VISA

Personal callers welcome at: **21 GREEN LANES, PALMERS GREEN, N.13.**

SPECIAL SUBSCRIPTION OFFER a Year's Subscription to

PRACTICAL ELECTRONICS

FOR ONLY £2

Copies are sent direct to your home at this amazing price reduction every month if you order three or more gift subscriptions from any of the magazines shown below.

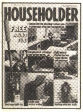
Magazine subscriptions make ideal gifts. They are so easy to arrange – with no shopping and no packing – and they form a year-long reminder to friends and relatives at home and overseas. Choose a magazine suiting the interests of your recipient from the list of titles below, and if you order three or more gift subscriptions to one or more of these magazines you can claim your own annual subscription to **Practical Electronics** for as little as £2 – an unbeatable price for ensuring that copies are delivered direct to your home every month. Even cheaper than waiting your turn at the newsagents'.
And for every gift subscription you order, you can instruct us to send a greetings card announcing your gift. So this year you save on Christmas cards too! *Get your order in NOW.*

Please send your order in to us in good time before the Christmas rush.

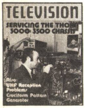
1
Practical Electronics
to addresses in:
U.K. **£10.60**
Other countries **£10.60**

2
Practical Wireless
to addresses in:
U.K. **£10.60**
Other countries **£10.60**

3
Everyday Electronics
to addresses in:
U.K. **£8.50**
Other countries **£9.50**



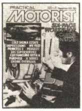
4
Practical Householder
to addresses in:
U.K. **£8.50**
Other countries **£9.50**



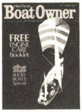
5
Television
to addresses in:
U.K. **£9.50**
Other countries **£10.50**

6
Practical Hi-fi
to addresses in:
U.K. **£9.50**
Other countries **£10.50**

7
Practical Woodworking
to addresses in:
U.K. **£9.50**
Other countries **£10.50**



8
Practical Motorist
to addresses in:
U.K. **£9.50**
Other countries **£10.50**



9
Practical Boat Owner
to addresses in:
U.K. **£10.00**
Other countries **£10.00**

All subscription orders must be accompanied by payment. Cheques should be made payable to IPC Magazines Limited and sent with this completed order form to Room 2613 King's Reach Tower, Stamford Street, London SE1 9LS.

Use this panel to order your own normal rate subscription to (Practical Electronics) or to claim your special offer rate.

MY NAME AND ADDRESS (please print all names and addresses)

NAME______________________________

ADDRESS____________________________

Enter full rate here if less than three other subscriptions are being ordered. £
If you are ordering 3 or more other subscriptions enter only £2 here

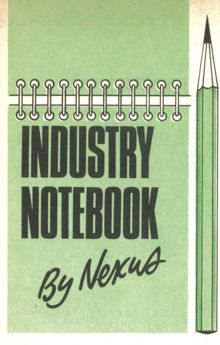
SEND MAGAZINE NO. ☐ TO:
NAME______________________________
ADDRESS____________________________
☐ please send a greetings card announcing this gift. £

SEND MAGAZINE NO. ☐ TO:
NAME______________________________
ADDRESS____________________________
☐ please send a greetings card announcing this gift. £

SEND MAGAZINE NO. ☐ TO:
NAME______________________________
ADDRESS____________________________
☐ please send a greetings card announcing this gift. £

I enclose full payment. TOTAL £

SIGNED____________________________



INDUSTRY NOTEBOOK

By Nexus

The Great Debate (3)

One of the hazards of monthly comment is that of being overtaken by events. This has happened in the Great Debate. The philosophical impact of VLSI on life-style and attitudes on which I wrote two months ago still stand.

But since my comments last month on the practicality or otherwise of pushing Britain into the forefront of technology and large-scale production of VLSI circuits, there has been positive action, or at least some positive statements.

First came the news of INMOS, the completely new entrant in the field, backed by the National Enterprise Board and headed up by former Texas Instruments and Mostek employee Dr Richard Petritz, assisted by Dr Paul Schroeder, another ex-Mostek man, and Iann Barron, the British whizz-kid who founded Computer Technology some years ago and said to have been the mediator between Dick Petritz and the NEB.

Then, the well-ventilated rumour that GEC was seeking an arrangement with Fairchild was confirmed by a public statement that this was indeed the case and that a joint 50/50 GEC/Fairchild venture was going ahead.

INMOS will get £25 million of goverment backing initially, with another £25 million top-up, if necessary, later on. Headquarters will be in the UK but pilot production in the USA. Eventually, so it is claimed, INMOS will have a manufacturing plant in the UK employing 4,000 people in a depressed area. INMOS director Paul Schoeder is quoted, "We think we have the most exciting enterprise in the world."

GEC's move is more realistic. It involves a working capital of £20 million (GEC is flush with cash and will put up £10 million) and aims at a production rate of £40 million of product in the first full year in 1981. The plant will be set up in existing buildings and employ about 1,000 people, will be on-stream ahead of INMOS and using proven technology the plant will actually be producing in 1980. GEC Semiconductors, in more specialised products, will continue as a separate entity and will enjoy some of the goverment support channelled through the Department of Industry.

Good news indeed. But it doesn't take much imagination to see which of these two operations will be the more successful. Realism, the GEC approach, must be a better bet than optimism. Private cash is always spent more prudently than public cash. GEC/Fairchild is already in the business and has marketing outlets. Not to mention technology. And from the business point of view GEC's Sir Arnold Weinstock has an unparalleled track record in shrewd management.

Among the many handicaps facing INMOS is uncertainty. A change of goverment could kill the project stone dead before it gets beyond the planning stage. Powerful voices in industry regard INMOS plans as controversial, if not downright fanciful, and should the Conservatives be returned to power it is already clear that they would not encourage the establishment of any new state-backed enterprises that could become a future burden on the economy.

A factor which could affect both INMOS and the GEC/Fairchild venture and, for that matter, all the semiconductor industry in the UK is the availability of scientists and engineers. INMOS is reported to be seeking 800 graduates and development engineers. GEC/Fairchild will need 300 engineers and 150 technicians. If these, or a fair proportion of them, are milked from existing operations this could weaken the whole infrastructure of the established UK semiconductor industry. One thing is certain, that any semiconductor engineer worth his salt need never be in the dole queue.

Employment

Accompanying the immediate convenience of new microelectronic applications, welcome to most of us, is the unwelcome impact on employment. Yet another set of figures, this time from Plessey, underlines the downward trend. In financial years 1973/74 turnover was £400 million with a world total of 76,000 employees. In FY 1977/78 the figures were £611 million with only 58,700 employees. If the overseas employees are eliminated from the figures, the UK employment by Plessey has dropped from 50,600 to 43,600 in the past three years.

Plessey, of course, was particularly hard-hit by savage cut-backs in orders from the Post Office, but even allowing for that special circumstance the trend is obvious and will continue.

Economics

The economics of microcircuits are fascinating. A study by Marconi engineers points out that for a four-channel mobile radio you can break even in cost by using a frequency synthesiser rather than four separate crystals. For a ten-channel set, use of a synthesiser saves £25 per unit. The synthesiser, of course, only uses a single standard reference crystal. So on a ten-channel set there is a saving of nine crystals. The set-maker gets more profit, the set-user has a simplified and less costly spares holding, but the poor old crystal manufacturer loses 90 per cent of his business. Well, not quite, because mobile radio is still a big growth area with the world market increasing at over nine per cent a year.

Electronic Warfare

The hush-hush business of electronic warfare (EW) is flourishing as never before. Mostly kept under security wraps in the UK, a glimpse of happenings is occasionally allowed. Decca, for example, has over a dozen equipments of various types in production for detection, analysis and jamming of radar signals. A £2 million order is in hand for the Royal Danish Navy and another £8 million of Decca EW equipment will go into Lynx helicopters for the Royal Navy.

What makes EW such good business (and so expensive) is that every advance in technology needs a new countermeasure. Marconi Radar Systems, for example, has just announced a new mobile long-range air-defence radar, the very thing for the 1980s and 1990s. Called Martello, it has every refinement to beat the hostile jammers. But back-room boffins will rise to the challenge. Marconi is one of the biggest firms in EW and it is conceivable that while Martello was in development in one laboratory, another team of engineers next door was already working on how to defeat the system.

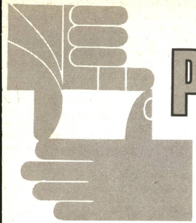
Video War

Discounts of up to 20 per cent are said to be offered by US dealers to shift home VTRs to a reluctant public. VTR sales in the USA have been only half those predicted. UK sales, however, have been as expected, according to manufacturers and dealers. But if stocks pile up in the USA it seems likely that surplus production could come to Europe and there could be some bargains in the shops, next year if not this.

TV Progress

The Matsushita factory in South Wales, opened only last year, is now stepping up production of National Panasonic colour TV sets to nearly 1,000 a week. The factory employs some 250 people.

Mullard is spending £24 million on updating TV tube production in the UK. The Department of Industry is helping with a £4·5 million handout. Mullard supply some 50 per cent of all tubes used in the UK and would like to supply as much as 75 per cent of the popular 22-inch size. Hopes that the tide of imports of TV tubes would be reduced by increased tariffs or import quotas are not bright. It looks therefore as if Mullard can increase market share only by intense price competition which would erode profits.



PATENTS REVIEW...

Copies of Patents can be obtained from :
the Patent Office Sales, St. Mary Cray, Orpington, Kent   Price 95p each

INCREASING SYNCHRONOUS MOTOR SPEED

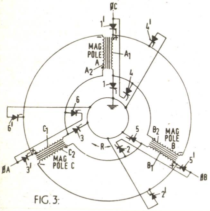


FIG. 3:

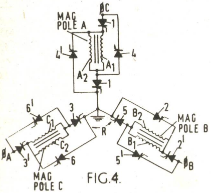


FIG.4.

Astro Dynamics of Massachusetts, USA have recently patented in BP 1 509 766 an intriguing proposal for producing high running speeds from a.c. motors, without the use of commutators, brushes, gear boxes or frequency changers.

Although the patent wording (originating from the USA) refers to 60Hz mains the principle of the invention is of course applicable to any mains frequency. On 60Hz mains the maximum running speed normally available from a synchronous motor is 3600rpm. The invention idea is to achieve higher speeds by using a three phase supply in a manner hitherto regarded as impossible.

It is, the inventors point out, an axiomatic rule for three phase power supply that two power phases must not be connected to the same load at the same time, since they differ in phase. The invention breaks this rule by the use of SCRs. The SCRs are triggered to switch on during the last half period of each phase, ideally the last 60 degrees before zero axis crossing where of course the SCR is automatically turned off again.

The motor poles are bifilar so that there are two windings around each pole, a first winding of each pole being used to pass the current from one phase and the other winding of the same pole used to pass the current from another phase. Figs. 1A, 1B and 1C show the manner in which each phase of the supply is chopped by the SCRs and figures 2A, 2B and 2C show the manner in which the chopped supply is fed to the windings on magnetic poles A, B and C respectively.

Thus the positive winding of the pole A receives its power from the C phase whereas the negative winding of the pole A obtains its power from the A phase. In similar fashion the windings of the magnetic pole B are powered by phases B and C and the windings for the pole C are powered by phases A and B. It follows that the individual magnetic poles share a different combination of excitation phases to produce 120Hz magnetomotive forces.

As the inventors point out the rules of three phase power supply, although apparently broken, are in fact observed. At no time are two phases of power applied to the same magnetic pole. For example phases A and C which are fed to pole A, are turned on alternately. To overcome the problems likely to result from current-lagging-voltage, the exact firing point of the SCRs needs careful selection.

The inventors claim to have modified and successfully operated a Westinghouse aircraft motor by re-winding it in bifilar manner. It is also suggested in passing that frequency tripling can be achieved by applying all three phases to each winding.

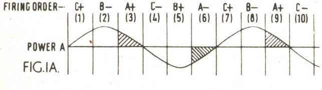


FIG.1A.

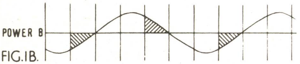


FIG.1B.

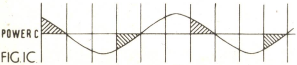


FIG.1C.

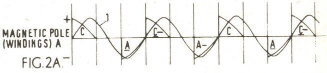


FIG.2A.

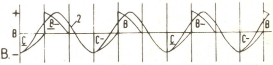


FIG.2B.

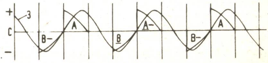


FIG.2C.

readout

. . . a selection from our postbag

Readers requiring a reply to any letter must include a stamped addressed envelope.
Opinions expressed in Readout are not necessarily endorsed by the publishers of Practical Electronics.

Another Range

Sir–Whilst attempting to construct the Linear Capacitance Meter, a few "deliberate mistakes", were found. After correcting these errors the instrument was tested and found to work correctly on all ranges, but 7 and 8 were found to be ×10 high.

To rectify this the 10MΩ resistor connected to S2b terminals 7 and 8 was disconnected, and terminals 7 and 8 were connected to 5 and 6 of S2b. This then brought ranges 7 and 8 into line with the others, i.e. in steps of ten. The switch used for the range selection has more than 8 positions, it was therefore decided to add another range: 1 volt = 10,000μF.

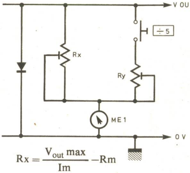
This was achieved by connecting terminal 8 of S2a to terminal 9 of S2a, and connecting the 10MΩ resistor that was removed from terminals 7 and 8 of S2b to terminal 9 of S2b.

A 50μA meter movement which was calibrated 0–5 has been used, hence the capacitance meter now has nine switched ranges:

(1) 500pF = 1V/100pF
(2) 5nF = 1V/1nF
(3) 50nF = 1V/10nF
(4) 500nF = 1V/100nF
(5) 5μF = 1V/1μF
(6) 50μF = 1V/10μF
(7) 500μF = 1V/100μF
(8) 5,000μF = 1V/1,000μF
(9) 50,000μF = 1V/10,000μF

To increase the accuracy of the instrument a divide by 5 switch has been added as shown in the diagram. The switch used for this *must* be a push-to-make type so that it cannot be inadvertently left on, as this could lead to funny shaped meter pointers.

The meter multipliers used were miniature potentiometers. These were adjusted to obtain the correct reading on the moving coil meter, whilst observing the readout on a digital meter connected between Vout and 0V. The meter used to read this voltage must be a high impedance meter or an oscilloscope, not the "run of the mill" 20kΩ/V type.



$$Rx = \frac{V_{out}\,max}{Im} - Rm$$

$$\frac{Rx.Ry}{Rx + Ry} = \frac{0{\cdot}2\,V_{out}\,max}{Im} - Rm$$

Where: Im = meter f.s.d. current
and Rm = meter resistance

This design has been proven by a friend of mine who has made the instrument incorporating the mods; needless to say he is highly delighted.

T. L. Woodger Reading.

Oh Yes!

Sir—I have just read "Readout" in P.E. October 1978 and find myself compelled to reply to R. E. Hurst's letter about pH. The concept of pH is a chemical one, and as a chemistry graduate I feel the pH scale must be looked at in context. The pH of a solution in equilibrium is equal to the negative logarithm of the hydrogen ion concentration i.e.

$$pH = -\log [H^+]$$

Using this expression the pH of a solution 1 molar in H^+ is in fact 0.

$$pH = -\log 1 = 0$$

All commercially available pH meters use a 0–14pH scale. As to R. E. Hurst's theory of "absolute acid" this is utter nonsense. If we were to push the theory to its limit a solution of 10 molar acid would have a pH of −1.

$$pH = -\log 10 = -1$$

Since concentrated acids are often stronger than 10 molar, even pH = −1 does not constitute "absolute acid". In short W. Hediger is quite correct in giving his pH meter a "0" on the scale and R. E. Hurst would do well to get his facts straight before going off the deep end over technicalities which have deeper roots than simple logarithm theory.

A. K. Strange, Grad R.I.C., F.Chem Soc
Bristol.

Okay!

Sir—When today I read what I had written in trying to make a simple point (No Oh! Readout, October 1978) my eyes nearly popped out. This is an object lesson in what can happen if you over simplify. My real point is that the logarithmic scale is an absolute with an origin which can be approached and conceived of but *never* reached. Log graduated scales disclose this, but scales which are linear because the log is used conceal the nature of the basis of the measurement. By omitting the "0" the nature of the underlying concept is shown.

Ugh! Mea culpa, mea maxima culpa. I hope the ancient alchemists will rest in peace.

R. E. Hurst
Blackpool.

(EnoupH, the matter is now at pH7—Ed.)

POINTS ARISING

TWO RANGE TIMER *(October 1978)*

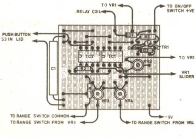


Fig. 2

FUMBLE NUDGE GAME *(April 1978)*

Resistor R23 appears correctly in the power supply diagram Fig. 5. It is shown incorrectly in the centre of the wiring diagram Fig. 6, where, in fact, IC2 pin 11 connects directly to IC11 pin 11.

KEYBOARD *(September 1978)*

Under "components", IC8 should be a 7474

METRONOME *(September 1978)*

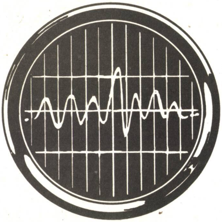
Diode D3 should be 7·5V and not 5·1V.

CAR BURGLAR ALARM *(December 1977)*

Constructors still undertaking this project, and unable to obtain the capacitors specified for C1 and C4 should follow the author's recommendation, which is to obtain 100μF/16V tantalum bead capacitors from Watford Electronics and increase R6 and R8 to 150kΩ.

LOOK! Here's how you master electronics

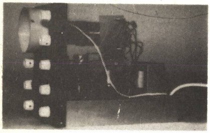
. . . the practical way



This new style course will enable anyone to have a real understanding of electronics by a modern, practical and visual method. No previous knowledge is required, no maths, and an absolute minimum of theory.

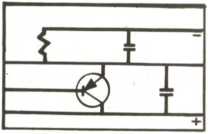
You learn the practical way in easy steps mastering all the essentials of your hobby or to further your career in electronics or as a self-employed electronics engineer.

All the training can be carried out in the comfort of your own home and at your own pace. A tutor is available to whom you can write, at any time, for advice or help during your work. A Certificate is given at the end of every course.



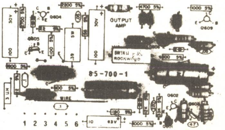
1 Build an oscilloscope

As the first stage of your training, you actually build your own Cathode ray oscilloscope! This is no toy, but a test instrument that you will need not only for the course's practical experiments, but also later if you decide to develop your knowledge and enter the profession. It remains your property and represents a very large saving over buying a similar piece of essential equipment.



2 Read, draw and understand circuit diagrams

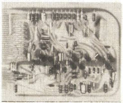
In a short time you will be able to read and draw circuit diagrams, understand the very fundamentals of television, radio, computers and countless other electronic devices and their servicing procedures.



3 Carry out over 40 experiments on basic circuits

We show you how to conduct experiments on a wide variety of different circuits and turn the information gained into a working knowledge of testing, servicing and maintaining all types of electronic equipment, radio, t.v. etc.

FREE GIFT



All students enrolling in our courses receive a free circuit board originating from a computer and containing many different components that can be used in experiments and provide an excellent example of current electronic practice.

Free!

To find out more about how to learn electronics in a new, exciting and absorbing way, just clip the coupon for a free colour brochure and full details of enrolment.

British National Radio & Electronic School

P.O. Box 156, Jersey, Channel Islands.

NAME ....

ADDRESS ....

.... Block caps please

PEB11

ERSIN
Multicore
5 CORE SOLDER

Handy size Reels and Dispensers

OF THE WORLD'S FINEST CORED SOLDER TO DO A PROFESSIONAL JOB AT HOME

Ersin Multicore Solder contains 5 cores of non-corrosive flux that instantly cleans heavil oxidised surfaces and makes fast, reliable soldering easy. No extra flux is required.

SAVBIT

handy solder dispenser

Contains 2·3 metres approx. of 1·22mm Ersin Multicore Savbit Solder. Savbit increases life of copper bits by 10 times.

Size 5 58p

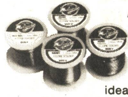
For soldering fine joints

Two more dispensers to simplify those smaller jobs: PC115 provides 6·4 metres approx. of 0·71mm solder for fine wires, small components and printed circuits.

PC115 69p

Or size 19A for kit wiring or radio and TV repairs. 2·1 metres approx. of 1·22mm solder.

Size 19A 63p



handy size reels of ***SAVBIT, 40/60, 60/40 and ALU-SOL*** *solder alloys*

These latest Multicore solder reels are ideal for the toolbox. Popular specifications cover all general and electrical applications, plus a major advance in soldering aluminium. Ask for a free copy of 'Hints on Soldering' containing clear instructions to make every job easy.

Ref.	Alloy	Diam. (mm)	Length metres approx.	Use	Price
Size 3	40/60 Tin/Lead	1·6	10·0	For economical general purpose repairs and electrical joints.	**£2·16**
Size 4	ALU-SOL	1·6	8·5	For aluminium repairs. Also solders aluminium to copper, brass etc.	**£2·46**
Size 10	60/40 Tin/Lead	0·7	39·6	For fine wires, small components and printed circuits.	**£2·38**
Size 12	SAVBIT	1·2	13·7	For radio, TV and similar work. Increases copper-bit life tenfold.	**£2·29**

BIB WIRE STRIPPER and CUTTER

Fitted with unique 8-gauge selector and handle locking device. Sprung for automatic opening. Strips flex and cable in seconds.

Pat. No. 1443913

Model 8B 97p

SOLDER-WICK

Absorbs solder instantly from tags, printed circuits etc. Only needs 40–50 watt soldering iron. Quick and easy to use. Non-corrosive.

Size AB10 97p

Sole U.K. Sales Concessionaires:
Bib Hi-Fi Accessories Limited,
Kelsey House, Wood Lane End, Hemel Hempstead, Herts. HP2 4RQ

Prices shown are recommended retail, inc. VAT. From electrical and hardware shops. In difficulty send direct, plus **20p** P. & P. Prices and specifications subject to change without notice.

4½in × 3½in **METER.** 30μA, 50μA or 100μA, **£5·43.** 19p P. & P.

2in × 2in meters 1mA, 500mA, **£3·65.** 16p P. & P.

60 × 45mm meters 50μA, 100μA 500μA and 1mA VU meter, **£4·46.** 11p P. & P.

6V BUZZERS. 50mm diameter 30mm high, **52p.** 15p. P. & P.

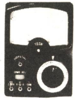
MICROPHONES FOR TAPE RECORDERS

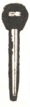
DM228R 200 ohm with 3·5 and 2·5mm Jack Plugs	**£1·30**
DM229R 50K with 3·5 and 2·5mm Jack Plugs	**£1·60**
DM18D 200 ohm with 5 and 3 pin Din Plugs	**£1·75**

Postage on above microphones 11p

MULTI-METER

Model IT1-2 20,000 ohm/volt, **£10·38.** 33p P. & P.





CARDIOID DYNAMIC MICROPHONE

Model UD-130 Frequency response 50–15,000c/s. Impedance Dual 50K and 600 ohms. **£8·02.** 26p P. & P.

TRANSFORMERS Primary 240V

6–0–6V	100mA	**£0·75**
9–0–9V	75mA	**£0·75**
12–0–12V	50mA	**£0·85**
12–0–12V	100mA	**£1·05**

Post on above transformers 30p.

9–0–9V	1A	**£1·80**
12–0–12V	1A	**£2·15**
15–0–15V	1A	**£2·36**
30–0–30V	1A	**£3·10**
6·3V	1½A	**£1·80**
6–0–6V	1½A	**£2·20**

Post on above transformers 45p.

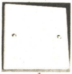
All above prices include V.A.T. Send 40p for new fully illustrated catalogue, S.A.E. with all enquiries. Special prices for quantity quoted on request.

M. DZIUBAS

158 Bradshawgate · Bolton · Lancs. BL2 1BA

BAD NEWS FOR KNOB TWIDDLERS

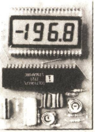
A 300W Lightdimmer with NO knob. Dimming and on/off functions are controlled by touch. Features include:



★ No mains rewiring.
★ Easy to build – uses one MOS 1C.
★ Switches on to preset brightness.
★ Can be switched and dimmed from many locations using TDE/K kit making 2-way switching easy.
★★ PRICE **£9.67** TDE/K **£1.08.**

LIGHTING CONTROL KITS (300W) TSD300K TOUCH-SWITCH & DIMMER combined. One touchplate for on/off. Small knob controls brightness. **£5.62**
TS300K TOUCHSWITCH. Two touchplates, ON/OFF **£4.32.**
TSA300K AUTOMATIC. One touchplate. Preset time delay off. **£4.32**
LD300K LIGHTDIMMER. **£3.02**

DIGITAL VOLTMETER/THERMOMETER KIT



Based on the 7106 single IC 3½ digit D.V.M. the Kit contains a PCB, resistors, capacitors, presets, I.C. and 0.5" liquid crystal display. Components are also included to enable the basic D.V.M. kit to be modified to a Digital Thermometer using a single transistor as the sensor.

ONLY £23.75

TRIAC BARGAINS

400V Plastic Case

3A	**64p**
6.5A with trigger	**86p**
8A	**80p**
12A	**90p**
16A	**113p**
20A	**178p**
25A	**205p**
SCR (C106D) 5A/400V	**54p**
Diac	**23p**

COMPONENTS

0.2" L.E.D.s
Red **11p** (**86p**/10)
Green **23p** Yellow **27p**

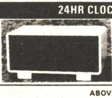
DL727 .5" display	**£1.62**
LCD .5" 4 digit	**£9.72**
LDR .5" dia.	**45p**
NE555 31p	(4 for **£1.08**)
741 27p	(5 for **£1.08**)
LM3911 temperature IC	**£1.08**
AY-5-1224	**£3.51**
AY-5-1230	**£5.23**
ZN1034E	**£1.94**
ICL7106 DVM IC	**£9.99**
IN4001	**7p**
IN4148	**5p**
BC182L	**11p**
2N3819	**25p**

MINI MAINS TRANSFORMERS

Standard 240V mains primary 100mA secondary

6–0–6V	**92p**
9–0–9V	**97p**
12–0–12V	**102p**

24HR CLOCK/APPLIANCE TIMER KIT



Switches any appliance of up to 1KW on and off at preset times once a day. KIT contains: AY–5–1230 Clock/Appliance Timer IC, 0.5" LED display, mains supply, display drivers, switches, LEDs, triac, complete with PCBs and full instructions. **£14.85**
White box (56 × 131 × 71mm) – drilled **£2.70**
– undrilled **£2.38**

ABOVE PRICES INCLUDE V.A.T.

Quantity discounts on request. Add 25p postage and packing. Mail order only to:

T.K. ELECTRONICS (PE) 106 Studley Grange Road, London, W7 2LX.

EASY BUILD SPEAKER DIY KITS

Specially designed by RT-VC for cost-conscious hi-fi enthusiasts, these kits incorporate two teak-simulate enclosures, two EMI 13" × 8" (approx.) woofers, two tweeters and a pair of matching crossovers. Supplied complete with an easy-to-follow circuit diagram, and crossover components. Input 15 watts rms, 30 watts peak, each unit. Cabinet size 20" × 11" × 9½" (approx.).

£28⁰⁰ STEREO PAIR + p & p £5.50

SPEAKERS AVAILABLE WITHOUT CABINETS.

It's the units which we supply with the enclosures illustrated Size 13" × 8" (approx.) woofer (EMI), 2½" app. tweeter, and matching crossover components. Power handling 15 watts rms, 30 watts peak.

£17⁰⁰ per stereo pair + p & p £3.40

BUILT AND READY TO PLAY

SPEAKERS Two models – Duo IIb, teak veneer, 12 watts rms, 24 watts peak, 18½" × 13½" × 7½" (approx.).
Duo III, 20 watts rms, 40 watts peak, 27" × 13" × 11½" appx

Duo IIb £17 PER PAIR p & p £6.50 Duo III £52 PER PAIR p & p £7.50

EASY TO BUILD

WITH SPEAKERS
NOT TO SCALE

RECORD PLAYER KIT for the D-I-Y man who requires a stereo unit at a budget price, comprising ready assembled stereo amp. module. Garrard auto/manual deck with cueing device, pre-cut and finished cabinet work. Output 4 watts per channel, phones socket and record/replay socket including 2 SPHERICAL HIFI speakers

£19.95 p&p £4.05

AM/FM STEREO TUNER AMPLIFIER CHASSIS ***COMPLETE.***

Ready built. Designed in a slim form for compact, modern installation

Rotary Controls Vol On/Off, Bass, Treble, Balance
Push Buttons for Gram, Tape VHF, MW, LW and 5 button rotary selection switch
Power Supply Selenium Bridge—35V DC from 210-250V AC 50Hz input
Aerial Ferrite 8" × ⅜" built into chassis for LW and MW plus flying lead for FM aerial
Power Output 5 watts per channel Sine at 2% THD into 15 Ohm. 7 watts speech and music
Tape Sensitivity Playback 400mV/30K OHM for max. output. Record 200mV/50K output available from 25KHz.. (150mV/100K) deviation FM signal. **Frequency Range (Audio)** 50Hz to 17 KHz within ± 1dB
Radio FM sensitivity for 3dB below limiting better than 10 uV
AM sensitivity for 20 dB S/N. MW 350 uV/Metre. LW 1mV/Metre.
Size approx. length 16" x height 2¾" x depth 4¾"

P & P £2.50 £19.95

VALUE FOR PERSONAL SHOPPERS

16o 16 VOLT MAINS TRANSFORMER, 2½ amp.	£2.50
BSR Record auto deck on plinth with stereo cartridge ready wired.	£11.95
LED 5 function men's digital watch stainless steel finish	£5.95
LCD 5 function men's digital watch stainless steel finish	£7.95
LCD 8 Function **CHRONOGRAPH** men's digital watch, stainless steel finish.	£13.95
125 Watt Power Amp Module	£13.95
Mains power supply for above unit.	£3.50
LENTEK Monitor loudspeaker cabinet size approx. 43¼" x 15½" x 15¼"	£24.95
100K Multiturn Varicap tuning pots, 6 for	£1.00
MUSIC CENTRE CABINET with hinged smoke acrylic top, finished in natural teak veneers, size 30¼" x 14½" x 7¼" approx.	£5.95
MULLARD Built power supply	£1.50
DECCA DC 1000 Stereo Cassette P.C.B. complete with switch oscillator coils and tape-heads.	£2.95
DECCA 20w Stereo speaker kit comprising 2 8" approx. bass units + 2 3½" approx. tweeter inc. crossovers	£20.00
'VIDEOMASTER' Super Score TV Game with pistol mains operation	£14.95
'VIDEO MASTER' Door Tunes (24 different titles)	£12.95
Micro cassette tape recorder	£13.95
7" TAPE TRANSPORT Mechanism—a selection of models from	£8.95
DIGITAL CLOCK RADIO Mains operated.	£10.95
STEREO RADIO/CASSETTE RECORDER, MW, LW, SW and Stereo VHF. 6 watts output Battery mains operation.	£75.00
PORTABLE RADIO/CASSETTE RECORDER, AM/FM with clock, LW, MW, SW, VHF mains/battery operation.	£41.95

Mullard

AUDIO MODULES IN BARGAIN PACKS CURRENT CATALOGUE PRICE £ AT OVER ~~25~~ PER PACK

SEE OUR PRICES

1 PACK 1. 2 x LP1173 10w. RMS output power audio amp modules, + 1 LP1182/2 Stereo pre amp for ceramic and auxiliary input.
OUR PRICE p+p £1.00 **£4.95**

2 PACK 2. 2 x LP1173 10w. RMS output power audio amp modules + 1 LP1184/2. Stereo pre amp for magnetic, ceramic and auxiliary inputs.
illus. OUR PRICE p+p £1.00 **£7.45**

3 PACK 3. 1 x LP1179/2 FM Tuning head with AM gang, 1 x LP1165/1 AM/FM IF module, 2 x LP1173/10w. RMS output power audio amp modules + 1 LP1182/2 Stereo pre amp for ceramic and auxiliary input.
OUR PRICE p+p £1.00 **£9.95**

ACCESSORIES

Suitable power supply parts including mains transformer, rectifier, smoothing and output capacitors.
£1.00 p+p **£1.95**

Recommended set of rotary stereo controls comprising BASS, TREBLE, VOLUME and BALANCE.
p+p 50p **95p**

THIS MONTHS OFFER
added to our bargain packs
When you buy Pack 3 at £9.95, together with a mains transformer at £1.95 and a set of controls for 95p you receive **FREE** a Mullard LP1400 Decoder to match Listed at **£11.90**
p & p £2.50 **£12.85**

TRADE ENQUIRIES INVITED

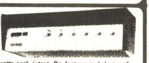
20 x 20 WATT STEREO AMPLIFIER
Viscount IV unit in teak-finished cabinet. Silver fascia with aluminium rotary controls and pushbuttons, red mains indicator and stereo jack socket. Function switch for mic. magnetic and crystal pick-ups, tape, tuner, and auxiliary Rear panel features two mains outlets. DIN speaker and input sockets, plus fuse. 20 + 20 watts rms. 40 + 40 watts peak.
£29.90 p&p £2.50

30 x 30 WATT AMPLIFIER KIT
For the experienced constructor complete in every detail. Similar facilities as Viscount IV amplifier. 60+60 peak.
£29.00 p&p £2.50

★ SPECIAL OFFER: PACKAGE PRICE WITH 30x30 KIT.
Mk II version operates into 4 to 15 ohms speakers. Specially designed by RT VC for the experienced constructor, complete in every detail. Same facilities as Viscount IV amplifier. 60+60 peak, supplied with **2 GOODMANS COMPACT** 12" Bass woofers with cropped sides. 14,000 Gauss magnet. 30 watts rms handling + 3¼" approx. tweeters and crossovers.
p&p £4.00 **£49.00**

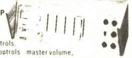
NOW AVAILABLE fully built and tested Output 30+30 watts rms. 60+60 peak.
p&p £2.50 **£39.00**

50 WATT MONO DISCO AMP
£29.95
P&P £2.50
Size approx.
13⅜" x 5¼" x 6¾"



50 watts rms. 100 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.
SPECIAL OFFER. The above 50 watt amp plus 4 Goodmans Type 8P. 8" speakers. Package price £45.00 + £4.00 P&P.

70 & 100 WATT MONO DISCO AMP



Size approx.
14" × 4" × 10¼".
Brushed aluminium fascia and rotary controls.
Five vertical slide controls master volume, tape level, mic level, deck level. PLUS INTER-DECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level control (PFL) lets YOU hear next disc before fading it in. VU meter monitors output level. Output 100 watts RMS 200 watts peak.

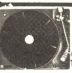
70 watt 140 watt peak £57
p & p £4.00
100 watt £65

ADD-ON STEREO CASSETTE TAPE DECK KIT

Designed for the experienced D.I.Y. man. This kit comprises of a tape transport mechanism, ready built and tested record replay electronics with twin V.U. meters and level control for mating with mechanism. Specifications: Sensitivity - Mic. 0.85 mV @ 20K OHMS; Din. 40mV @ 400K OHMS: Output - 300mV RMS per channel @ 1KHz from 2K OHMS source: Cross Talk - -30db: Tape Counter - 3 Digit- Resettable: Frequency Response - 40Hz -8KHz ± 6db: Deck Motor - 9 Volt DC with electronic speed regulations: Key Functions - Record, Rewind, Fast Forward, Play, Stop & Eject.

£19⁹⁵ p & p £2.50

Opt. extras: Mains transformer to suite **£2.50** + £1 p & p.



BDS 95 TYPE Belt drive chassis turntable less cartridge.	£2.55 p & p	£24.95
BSR MP60 TYPE Single play record player less cartridge.	£2.55 p & p	£15.95
CARTRIDGES to suit above Tenorel magnetic stereo.		£4.95
BSR automatic record player deck, cueing device and stereo ceramic head.	£2.55 p & p	£9.95
GARRARD DECK CC10A. Record changer with cue and stereo ceramic cartridge: Size 12" x 8½" approx.	£2.00 p & p	£7.95

PERSONAL SHOPPERS

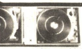
GARRARD 86SB Deck.	£24.95
GARRARD35SB Deck.	£24.95
GARRARD SP25 MKIV Deck with Shure head.	£26.95

RTVC

323 EDGWARE ROAD, LONDON W2
21D HIGH STREET, ACTON W3 6NG
ALL PRICES INCLUDE VAT AT 12½%

All items subject to availability. Price correct 1.9.78 and subject to change without notice.

Order by giving credit card NUMBER only



PORTABLE DISCO CONSOLE

Here's the big-value portable disco console from RT-VC! It features a pair of BSR MP 60 type auto-return, single play professional series record decks. Plus all the controls and features you need to give fabulous disco performances. Simple connects into your existing slave or external amplifier.

with built-in pre-amp

p & p £6.50 **£64.00**

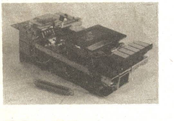
Personal Shoppers EDGWARE ROAD LONDON W2 Tel: 01-723 8432. 9.30am-5.30pm. Half day Thursday. ACTON: Mail Order only. No callers GOODS NOT DESPATCHED OUTSIDE UK

GODDARD'S COMPONENTS MAIL ORDER DEPT.

110 LONDON ROAD, ST. ALBANS, HERTS. AL1 1NX

Callers Welcome MON-SAT: 9.30-5.30
THURS: Closed all day
Lunch: MON-FRI: 1.30-2.30, SAT: 1.00-2.00

STEREO



CASSETTE RECORDER DECK

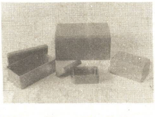
with + solenoid auto-stop
+ CrO2 switch
+ piano key operation
+ twin level meters
+ mic. sockets

Tech. Spec.:
Bias and erase freq. 88 kHz
4 ICs 8 Transistors
1 SCR 10 Diodes

Diagrams and top panel template supplied

£25.75 + £1.25 p&p

HIT-BOX



SHOCK-PROOF POLYSTYROL IN GREY
4mm thick walls
Larger sizes are pillar fixing
Smaller sizes are slotted
Inside Measurements:

Box No.	Breadth mm	Length mm	Height mm	Weight gm
1001	60	90	50	100
1002	75	130	61	175
1003	90	160	71	285
1004	93	193	95	340
1005	125	220	110	575

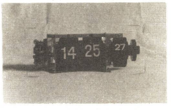
1001 – **90p**
1002 – **£1.60**
1003 – **£1.80**
1004 – **£2.00**
1005 – **£3.00**
50p each p&p. **£1.00** for 3 p&p

TRADE ENQUIRIES WELCOME!

DIGITAL CLOCK

BATTERY DROP LEAF CLOCK MOVEMENT

Hrs. Mins. Date
Easy-to-set regulator screw
Size: 140mm x 85mm x 60mm
Window size: 63mm x 28mm
No. height: 19mm
Date height: 10mm
Weight: 270gm



£4.95 + 50p p&p

LCD WATCHES

TOUCH GENTS CTG
£14.95

LADIES S/S C652
£16.95

UNISEX C551
6 Colours
£11.95

LARGE GENTS C165
£9.95

ALL WATCHES 5 FUNCTION . . . 1 YEAR GUARANTEE
P&P **50p** per watch, Inc. Insurance

We can now supply TOP PANEL FOR STEREO CASSETTE DECK £3.50 + 50p P&P · ALL PRICES INCLUDE VA

TRAMPUS ELECTRONICS LTD.

ELECTRONIC COMPONENT CENTRE
58-60 GROVE ROAD, WINDSOR, BERKS
SL4 1HS (TRADE AND EXPORT WELCOME)
HOTLINE FOR TELEPHONE CREDIT CARD ORDERS — WINDSOR 54525

SEMICONDUCTOR DISTRIBUTORS

ETI READERS OFFER: OVER £10 DISCOUNT 5% OFF. (THIS MONTH)
QUANTITY DISCOUNT FOR 100 OF ONE TYPE 10% OFF 1 UP PRICE

Cheque or cash orders over £5 Post Free. Other orders add 20p Post & Packing. Credit Card orders £5 min. by post or phone. + Post & Packing 20p. UK add 8% to prices marked'. Add 12½% VAT to all other prices. Free price list send S.A.E.
All devices to makers specifications. Please quote ETI ad as prices may change. E.&O.E. 1978. Callers welcome Tues to Sat (Lunch 1-2).

MICRO POWER SUPPORT
All full spec Grade 1 displays
DL704 CC or DL707 CA 0.3" £1.25*
FND500 CC/161 C 0.6" £1.25*
MAN6A Type/161A 0.6" £1.25*
DL747 CA or DL 750 CC £1.69*
Clock IC AY51224 £3*
Display PCB 6 Digit 0.6" £1*
LEDS. Bright full spec.
0.2" or 0.125" Red 10p*
TIL209 Red & Clip 12p*
0.2" Dia Red & Clip 12p*
Yellow or Green LEDs
0.2" or 0.125" Dia. All 20p*
12 volt Fluorescent Light £5*
Jackson Tuner 370pf £1
Trimmer 0-8 or 5 to 40pf 25p
Coil Former & Slug 0.3" Dia 25p
Relay Mini 3 Pole 12 volt Coil £1*
RS Type Bleeper 9 to 12v £1.50*
Dalo PCB Pen 2 nibs 70p*
TUB Ferric CHL ½kg. £1*
Decon Board Cleaner Pad 50p*
6x4" Nylon/Copper Board 60p*
Vero Stocked A11 10% off i.e. 3¾"x5"x0.1" Board 56p*

6"x4" Dil Board £2.25*
PP3 or PP9 Clips. Pair 15p*
Din Plugs. All 19p
Din Sockets. All 10p
Disco Strobe Tube £5*

DEVELOPMENT PARCELS. All £5 each
SET 1: 250x50 volt Ceramic Capacitors 5%. 10 each. From 22pf to 0.1uf £5
SET 2: Tantalums 1uf to 200uf 20v to 35 volt. Total 50 capacitors £5
SET 3: Electrolytic 25 volt 10 each (80) 1/2/5/10/47/100/220/1000 £5
SET 4: ⅓ watt Resistors 5% C.F. 10 each 10 ohm to 10 meg ohm. Total 500. Bulk packed in 1 bag £5
SET 5: Zeners 400mw 5 each. 20 values 3 volt to 33 volt (Total 100) £5
SET 6: —100 Presets £5
SET 7: Heatsinks. 10 off. Each TO18. TO5. TV4 (TO99) and small TO 3 £5*

PASSIVE GEAR
Resistors ½ watt 5% CF 2p
Presets Type PR Vert 10p
Type 45 Pots Log & Lin 25p

CAPACITORS
Ceramic 50v 5% Hi Stab 22pf to 0.1uf & .22/47 5p
Tantalum Caps 12p

ELECTROLYTICS 25 volt
1/10/47/100uf. All 10p
(50 volt 20p) 220 or 470uf 30p
1000uf 25 volt 35p
KNOBS. 1" dia & trim 15p
HEAT SINKS. TO5 & 18 9p*
TV4 25p*. TO3 small 25p*

DISCO TRIAC 10A 400v £1*
BR100 Diac 25p*
C106D 4A 400v SCR 55p*
TAG 1/400 1amp 55p*. 1/600 65p*
Switches Mini SPST 55p*
Mini DPDT 69p*. Centre off 89p*
Slide Switch 25p*
Push 'On' 35p

FULL SPEC PAKS ALL £1
Pak A: 12 x Red LEDS £1*
Pak B: 6 x 741C 8 pin £1*
Pak C: 4x2 N13055. TO 3 £1*
Pak D: 12 x BC109 £1*
Pak E: 13 x BC182 £1
Pak F: 13 x 2N3704 £1
Pak G: 7 x BFY Fl £1*
Pak H: 7 x 2N3819 efet £1
New Pak I: 10 x Metal Trim. Knob ½" dia (synthesiser etc.) £1*
Pak J: 6 x 2N3053 £1*
Pak K: 50xIN4148 £1
Pak L: 50 x 33uf 10 volt electrolytic £1
Pak M: 4 x Pairs Plastic Power 2amp 60 volt. NPN/PNP BD131/2 Type £1
Pak N: 50 x OA81/91 £1
Pak P: 20 x Plastic 109 £1
Pak Q: 50 x 220uf 6.3v Volt Electrolutic £1
Pak R: 14 x BC107 £1
Pak S: 14 x BC108 £1
Pak T: Top selling 10 x NPN Plastic Power 60 volt 2 amp BDBI Type £1

TRANSISTORS

Look at our Pak T. Ten Plastic Power £1
Or Pak C: 4 x 2N3055 £1*
Matching 20p*. Ins Kit 10p*

AC127	17p*	BFY50	16p*
AC176	10p*	BFY51	16p*
AC187	20p*	BFX29	28p*
AD161	40p*	BSX20	18p*
AF162	40p*	MJ2955	£1 *
AF239	42p*	MJE340	44p*
BC107	8p*	MJE2955	£1*
BC108	8p*	MJE3055	80p*
BC109	9p*	MPU131	35p
BC109C	15p*	ORP12	55p*
BC147	12p*	TIP41A	60p*
BC148	12p	TIP42A	65p*
BC149	12p	TIP2955	60p*
BC157	15p	TIP3055	50p*
BC158	15p	TI543	35p
BC159	15p	2N2646	39p*
BC167	10p	2N2905	22p*
BC168	11p	2N2926Y	10p
BC169	12p	2N3053	16p*
BC177	18p*	2N3055	45p
BC178	16p*	2N3614	£1*
BC179	18p*	2N3702	9p
BC182	10p	22N3704	9p
BC183	10p	2N3706	9p
BC184	10p	2N3819E	18p
BC212	12p	2N3820	38p
BC213	12p	2N3904	15p
BC214	12p	2N3906	15p
BCY71	20p*	2N4347	50p*
BD131	37p*	2N5457	32p
BD132	37p*	2N5777	44p*
BD695	69p*	TIL31	£2*
BD696	69p*	TIL63	£1*

DIODES & BRIDGE
1A 50v Bridge 22p*
IN4148 or IN914 4p*
OA81 or OA91 5p
OA200 & 202 10p
IN4001 1A50v 5p*
IN4004 7p*. IN4007 15p*

7400N SERIES TTL
ALL FULL SPEC BRANDED

7400	8p*	7475	44p*
7401	9p*	7476	35p*
7402	10p*	7480	39p*
7403	10p*	7481	£1*
7404	17p*	7482	£1*
7405	9p*	7483	£1*
7406	28p*	7485	£1*
7407	28p*	7486	35p*
7408	12p*	7490	36p*
7409	12p*	7491	75p*
7410	10p*	7492	35p*
7411	22p*	7493	35p*
7412	22p*	7494	75p*
7413	28p*	7495	75p*
7416	28p*	7496	85p*
7417	28p*	74100	£1.15*
7420	10p*	74107	29p*
7423	26p*	74121	27p*
7425	26p*	74123	59p*
7426	26p*	74141	95p*
7430	10p*	74143	£3.14*
7432	20p*	74145	85p*
7440	14p*	74147	£1.69*
7441	79p*	74152	£2*
7442	87p*	74154	£2*
7445	69p*	74155	80p*
7446	88p*	74156	80p*
7447	82p*	74157	£1*
7448	£1*	74164	£1*
7450	15p*	74174	£1*
7451	15p*	74176	£1*
7453	15p*	74190	£2*
7454	15p*	74192	£2*
7460	15p*	74193	£2*
7470	29p*	74194	£2*
7472	26p*	74196	£1.30*
7473	25p*	74197	£1*
7474	29p*	74198	£2*

CMOS TOP VALUE

4000	15p*	4066	58p*
4001	15p*	4067	£4*
4002	17p*	4069	22p*
4006	£1*	4070	32p*
4007	18p*	4071	21p*
4008	92p*	4072	21p*
4009	58p*	4073	21p*
4010	58p*	4075	23p*
4011	15p*	4076	£1.29*
4012	18p*	4077	40p*
4013	55p*	4078	21p*
4015	93p*	4081	22p*
4016	52p*	4082	21p*
4017	99p*	4089	£1.50*
4018	99p*	4093	85p*
4020	£1*	4507	55p*
4021	£1*	4508	£3*
4022	90p*	4510	£1.35*
4023	20p*	4511	£1.68*
4024	76p*	4512	98p*
4025	19p*	4514	£2.65*
4027	55p*	4516	£1.28*
4028	90p*	4518	£1.05*
4029	£1*	4520	£1.10*
4030	58p*	4521	£2.68*
4032	£1*	4522	£2*
4034	£2*	4528	99p*
4035	£1.20*	4534	£7.88*
4038	£1.08*	4536	£3.60*
4040	£1.05*	4541	£1.50*
4041	86p*	4543	£1.75*
4042	81p*	4553	£4.49*
4043	96p*	4556	78p*
4044	95p*	4558	£1.17*
4046	£1.30*	4566	£1.59*
4047	99p*	4569	£3.59*
4049	52p*	4583	£1.10*
4060	£1.15*	4585	£2.05*
4063	£1.10*		

DIL SOCKETS Low Profile				
	8 pin	12p*	28 Pin	£1
	24 Pin	50p	40 Pin	£1.50
	14 or 16 Pin	15p		

TOP TWOSOME!
555 8 Pin Timer 27p*
741C Full spec DIL 8. Branded Op Amp 19p*

NEW LINEARS Data 10p
TL170 Hall effect 69p*
TL071 Lo noise 741 75p*
TL081 FET 8p. 741 69p*
TL083 FET 747 £1.49*
TL080 FET 748/308 £1.15*

IC SUPERMARKET
301 Op Amp 30p*
555 Timer (NE555) 27p*
556 Dual 555 70p*
710 Comparator 40p*
723 Regulator 45p*
741C 8 Pin DIL OPA 19p*
741C TO99 or DIL 14 39p*
748C Op Amp 33p*
3900 Quad Op Amp 55p*
7805 1 Amp 5 volt 95p*
7805 TO3(309K) £1*
7808 or 7812 £1.25*
7815 15 volt plastic 69p*
7900 Negative Series £2.50*
8038 Sig Generator £3.55*
76013 & 76023 £1.35
CA3130 & CA3140 94p*
LM380 1 watt Amp 85p
LM381 Dual Preamp £1.55
LM387 Dual Preamp £1
LM3900 Quad OPA 55p*
MC1310 Decoder £1
MC1460. 1461 & 1469 £3*
MCMOS 14433. A/D £5*
NE536 FET OPA £4*
NE555 Timer 27p*
NE556 Dual 555 70p*
TBA810 7w AF £1
ZN414 Radio 65p

15-240 WATTS!

HY5
Preamplifier

The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (mag Cartridge, tuner, etc.) are catered for internally, the desired function is achieved either by a multi-way switch or direct connection to the appropiate pins. The internal volume and tone circuits merely require connecting to external potentiometers (not included). The HY5 is compatible with all I.L.P. power amplifiers and power supplies. To ease construction and mounting a P.C. connector is supplied with each pre-amplifier.

FEATURES: complete pre-amplifier in single pack; multi-function equalisation; low noise; low distortion; high overload; two simply combined for stereo.
APPLICATIONS: hi-fi; mixers; disco; guitar and organ; public address.
SPECIFICATION: Inputs–magnetic pick-up 3mV; ceramic pick-up 30mV; tuner 100mV; microphone 10mV; auxiliary 3–100mV; input impedance 47kΩ at 1kHz. Outputs—tape 100mV; main output 500mV R.M.S. Active Tone Controls—treble ±12dB at 10kHz; bass ±12dB at 100Hz. Distortion—0·1% at 1kHz; signal/noise ratio 68dB. Overload—38dB on magnetic pick-up. Supply Voltage—±16–50V.

Price **£6·27** + 78p VAT. P. & P. free
HY5 mounting board B.1. **48p** + 6p VAT. P. & P. free

HY30
15W into 8Ω

The HY30 is an exciting New kit from I.L.P. It features a virtually indestructible I.C. with short circuit and thermal protection. The kit consists of: I.C., heatsink, P.C. board, 4 resistors, 6 capacitors, mounting kit, together with easy to follow construction and operating instructions. This amplifier is ideally suited to the beginner in audio who wishes to use the most up to date technology available.

FEATURES: complete kit; low distortion; short, open and thermal protection; easy to build.
APPLICATIONS: updating audio equipment; guitar practice amplifier; test amplifier; audio oscillator.
SPECIFICATION: Output Power—15W R.M.S. into 8Ω. Distortion—0·1% at 15W. Input Sensitivity—500mV. Frequency Response—10Hz-16kHz –3dB.

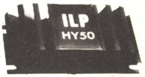
Price **£6·27** + 78p VAT. P. & P. free

HY50
25W into 8Ω

The HY50 leads I.L.P.'s total integration approach to power amplifier design. The amplifier features an integral heatsink together with the simplicity of no external components. During the past three years the amplifier has been refined to the extent that it must be one of the most reliable and robust High Fidelity modules in the World.

FEATURES: low distortion; integral heatsink; only five connections; 7 amp output transistors; no external components.
APPLICATIONS: medium power hi-fi systems; low power disco; guitar amplifier.
SPECIFICATION: Input Sensitivity—500mV. Output Power—25W R.M.S. into 8Ω. Load Impedance—4–16Ω. Distortion—0·04% at 25W at 1kHz. Signal/Noise Ratio—75dB. Frequency Response—10Hz-45kHz –3dB. Supply Voltage—±25V. Size—105 × 50 × 25mm.

Price **£8·18** + £1·02 VAT. P. & P. free

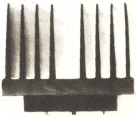


HY120
60W into 8Ω

The HY120 is the baby of I.L.P.'s new high power range, designed to meet the most exacting requirements including load line and thermal protection this amplifier sets a new standard in modular design.

FEATURES: very low distortion; integral heatsink; load line protection; thermal protection; five connections; no external components.
APPLICATIONS: hi-fi; high quality disco; public address; monitor amplifier; guitar and organ.
SPECIFICATION: Input Sensitivity—500mV. Output Power—60W R.M.S. into 8Ω. Load Impedance—4–16Ω. Distortion—0·04% at 60W at 1kHz. Signal/Noise Ratio—90dB. Frequency Response—10Hz-45kHz –3dB. Supply Voltage—±35V. Size—114 × 50 × 85mm.

Price **£19·01** + £1·52 VAT. P. & P. free



HY200
120W into 8Ω

The HY200 (now improved to give an output of 120 watts) has been designed to stand the most rugged conditions such as disco or group while still retaining true hi-fi performance.

FEATURES: thermal shutdown; very low distortion; load line protection; integral heatsink; no external components.
APPLICATIONS: hi-fi; disco; monitor; power slave; industrial; public address.
SPECIFICATION: Input Sensitivity—500mV. Output Power—120W R.M.S. into 8Ω. Load Impedance—4–16Ω. Distortion—0·05% at 100W at 1kHz. Signal/Noise Ratio—96dB. Frequency Response—10Hz-45kHz –3dB. Supply Voltage—±45V. Size—114 × 50 × 85mm.

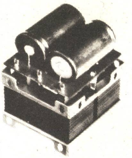
Price **£27·99** + £2·24 VAT. P. & P. free

HY400
240W into 4Ω

The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4Ω! It has been designed for high power disco or public address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power hi-fidelity power module.

FEATURES: thermal shutdown; very low distortion; load line protection; no external components.
APPLICATIONS: public address; disco; power slave; industrial.
SPECIFICATION: Output Power—240W R.M.S. into 4Ω. Load Impedance—4–16Ω. Distortion—0·1% at 240W at 1kHz. Signal/Noise Ratio—94dB. Frequency Response—10Hz-45kHz –3dB. Supply Voltage—±45V. Input Sensitivity—500mV. Size—114 × 100 × 85mm.

Price **£38·61** + £3·09 VAT. P. & P. free



POWER SUPPLIES: PSU36—suitable for two HY30s **£6·44** + 81p VAT. P. & P. free. **PSU50**—suitable for two HY50s **£8·18** + £1·02 VAT. P. & P. free. **PSU70**—suitable for two HY120s **£14·58** + £1·17 VAT. P. & P. free. **PSU90**—suitable for one HY200 **£15·19** + £1·21 VAT. P. & P. free. **PSU180**—suitable for two HY200s or one HY400 **£25·42** + £2·03. VAT. P. & P. free.

Free post + packing applicable to U.K. only.

TWO YEARS' GUARANTEE ON ALL OUR PRODUCTS

I.L.P. Electronics Ltd.
Crossland House,
Nackington, Canterbury
Kent CT4 7AD
Tel (0227) 64723

Please supply ....
Total Purchase price ....
I Enclose: Cheque ☐ Postal Orders ☐ Money Order ☐
Please debit my Access account ☐ Barclaycard account ☐
Account number ....
Name and Address ....
....
Signature ....

Registered office No. 1032630

RST

VALVE MAIL ORDER CO.

Climax House
Fallsbrook Road, London SW16 6ED

SPECIAL EXPRESS
MAIL ORDER SERVICE

	£p
AA119	0·20
AAY30	0·13
AAY32	0·15
AAZ13	0·25
AAZ15	0·31
AAZ17	0·25
AC107	0·75
AC125	0·30
AC126	0·25
AC127	0·25
AC128	0·25
AC141	0·20
AC141K	0·35
AC142	0·20
AC142K	0·30
AC176	0·25
AC187	0·25
AC188	0·25
ACY17	0·65
ACY18	0·65
ACY19	0·65
ACY20	0·65
ACY21	0·65
ACY39	1·25
AD149	0·70
AD161	0·75
AD162	0·75
AF106	0·45
AF114	0·25
AF115	
AF116	0·25
AF117	0·25
AF139	0·40
AF186	1·50
AF239	0·45
AFZ11	2·75
AFZ12	2·75
ASY26	0·45
ASY27	0·50
ASZ15	1·25
ASZ16	1·25
ASZ17	1·25
ASZ20	0·75
ASZ21	1·50
AU113	1·70
AUY10	1·70
BA145	0·15
BA148	0·15
BA154	0·10
BA155	0·12
BA156	0·13
BAW62	0·05
BAX13	0·07
BAX16	0·07
BC107	0·12
BC108	0·12
BC109	0·13
*BC113	0·15
*BC114	0·18
*BC115	0·19
*BC116	0·19
*BC117	0·22
*BC118	0·16
*BC125	0·18
*BC126	0·25
*BC135	0·15
*BC136	0·19
*BC137	0·16
*BC147	0·10
*BC148	0·10
*BC149	0·13
*BC157	0·12
*BC158	0·11
*BC159	0·13
*BC167	0·13
*BC170	0·16
*BC171	0·14
*BC172	0·13
*BC173	0·15
BC177	0·19
BC178	0·18
BC179	0·20
*BC182	0·11
*BC183	0·11
*BC184	0·12
*BC212	0·14
*BC213	0·14
*BC214	0·17
*BC237	0·17
*BC238	0·12
BC301	0·45
BC303	0·60
*BC307	0·20
*BC308	0·18
*BC327	0·22
*BC328	0·18
*BC337	0·19
*BC338	0·18
BCY30	1·00
BCY31	1·00
BCY32	1·00
BCY33	0·90
BCY34	0·90
BCY39	3·00
BCY40	1·25
BCY42	0·30
BCY43	0·32
BCY58	0·23
BCY70	0·18

	£p
BCY71	0·22
BCY72	0·17
BCZ11	1·50
BD115	0·60
BD121	1·50
BD123	1·50
BD124	
BD131	0·51
BD132	0·54
*BD135	0·35
*BD136	0·36
*BD137	0·37
*BD138	0·40
*BD139	0·43
*BD140	0·47
BD144	2·00
BD181	1·38
BD182	1·48
BD237	0·80
BD238	0·85
BDX10	0·75
BDX32	2·25
BDY20	1·42
BDY60	0·75
BF115	0·39
BF152	0·25
BF153	0·25
BF154	0·25
BF159	0·35
BF160	0·30
BF167	0·39
BF173	0·39
BF177	0·38
BF178	0·45
BF179	0·48
BF180	0·45
BF181	0·45
BF182	0·45
BF183	0·45
BF184	0·39
BF185	0·37
*BF194	0·12
*BF195	0·11
*BF196	0·13
*BF197	0·14
BF200	0·32
*BF224	0·20
*BF244	0·35
BF257	0·37
BF258	0·42
BF259	0·45
*BF336	0·50
*BF337	0·53
*BF338	0·55
BFS21	2·27
BFS28	1·38
*BFS61	0·25
*BFS98	0·25
BFW10	0·90
BFW11	0·90
BFX84	0·38
BFX85	0·41
BFX87	0·35
BFX88	0·32
BFY50	0·28
BFY51	0·26
BFY52	0·26
BFY64	0·30
BFY90	1·32
BSX19	0·34
BSX20	0·34
BSX21	0·32
BT106	1·25
BTY79/400R	3·19
*BU205	2·25
*BU206	2·25
*BU208	2·50
BY100	0·45
BY126	0·14
BY127	0·15
BZX61	0·20
Series	
BZY88	0·13
Series	
CRS1/05	0·45
CRS1/40	0·60
CRS3/05	0·45
CRS3/40	0·75
CRS3/60	0·90
GEX66	1·50
GEX541	1·75
GJ3M	0·75
GJ5M	0·75
GMO378A	1·50
*KS100A	0·40
MJE340	0·58
MJE370	0·65
MJE371	0·81
MJE520	0·65
MJE521	0·75
MJE2955	1·25
MJE3055	0·75
*MPF102	0·30
*MPF103	0·30
*MPF104	0·30
*MPF105	0·30
*MPSA06	0·25
*MPSA56	0·25

	£p
*MPSU01	0·32
*MPSU06	0·40
*MPSU56	0·45
NKT401	2·00
NKT403	1·73
NKT404	1·73
NE555	0·45
OA5	0·75
OA7	0·55
OA10	0·55
OA47	0·14
OA70	0·30
OA79	0·30
OA81	0·30
OA85	0·30
OA90	0·08
OA91	0·08
OA95	0·08
OA200	0·10
OA202	0·11
OA210	0·75
OA211	0·75
OAZ200	0·65
OAZ201	0·65
OAZ206	0·65
OAZ207	0·65
OC16	1·25
OC20	2·00
OC22	2·50
OC23	2·75
OC24	3·50
OC25	0·90
OC26	0·90
OC28	2·00
OC29	2·00
OC35	1·50
OC36	1·50
OC41	0·50
OC42	0·50
OC43	1·50
OC44	0·50
OC45	0·50
OC71	0·45
OC72	0·45
OC73	1·00
OC74	0·75
OC75	0·60
OC76	0·50
OC77	1·20
OC81	0·75
OC81Z	1·00
OC82	0·75
OC83	0·55
OC84	0·60
OC122	1·50
OC123	1·55
OC139	2·25
OC140	1·95
OC141	2·25
OC170	0·75
OC171	0·75
OC200	1·00
OC201	1·50
OC202	
OC203	
OC204	1·25
OC205	1·75
OC206	1·75
OC207	1·25
OCP71	1·25
ORP12	0·83
*R2008E	2·25
*R2009	2·25
*R2010B	2·25
T1C44	0·36
T1C226D	1·30
T1L209	0·25
*T1P29A	0·50
*T1P30A	0·60
T1P31A	0·62
T1P32A	0·75
T1P33A	1·00
T1P34A	1·20
T1P41A	0·70
T1P42A	0·90
T1P2955	1·00
T1P3055	0·50
*T1S43	0·35
*ZS140	0·25
*ZS170	0·12
*ZS178	0·54
*ZS271	0·22
*ZS278	0·56
*ZTX107	0·11
*ZTX108	0·10
*ZTX109	0·12
*ZTX300	0·12
*ZTX301	0·13
*ZTX302	0·17
*ZTX303	0·17
*ZTX304	0·19
*ZTX311	0·12
*ZTX314	0·20
*ZTX500	0·13
*ZTX501	0·14
*ZTX502	0·16
*ZTX503	0·17
*ZTX504	0·20
*ZTX531	0·20

	£p
*ZTX550	0·16
1N914	0·07
1N916	0·07
1N4001	0·06
1N4002	0·07
1N4003	0·08
1N4004	0·09
1N4005	0·13
1N4006	0·15
1N4007	0·15
1N4009	0·15
1N4148	0·07
1N5400	0·14
1N5401	0·16
1S44	0·06
1S920	0·08
1S921	0·08
2G301	1·00
2G302	1·00
2G306	1·10
2N404	0·60
2N696	0·25
2N697	0·16
2N698	0·30
2N705	0·80
2N706	0·12
2N708	0·21
2N930	0·26
2N1131	0·26
2N1132	0·26
2N1302	0·37
2N1303	0·37
2N1304	0·45
2N1305	0·45
2N1306	0·50
2N1307	0·50
2N1308	0·60
2N1309	0·60
2N1613	0·33
2N1671	1·50
2N1893	0·33
2N2147	1·40
2N2148	1·65
2N2218	0·33
2N2219	0·42
2N2220	0·35
2N2221	0·22
2N2222	0·25
2N2223	2·75
2N2368	0·17
2N2369A	0·21
2N2484	0·21
2N2646	0·50
2N2904	0·35
2N2905	0·35
2N2906	0·25
2N2907	0·21
*2N2924	0·15
*2N2925	0·17
*2N2926	0·13
2N3053	0·25
2N3054	0·50
2N3055	0·65
2N3440	0·60
2N3441	0·80
2N3442	1·20
2N3525	0·90
2N3614	1·20
*2N3702	0·15
*2N3703	0·15
*2N3704	0·15
*2N3705	0·15
*2N3706	0·14
*2N3707	0·18
*2N3708	0·14
*2N3709	0·15
*2N3710	0·14
*2N3711	0·15
2N3771	1·60
2N3772	1·70
2N3773	2·65
*2N3819	0·36
*2N3820	0·46
*2N3823	0·60
2N3866	1·00
*2N3904	0·21
*2N3905	0·22
*2N3906	0·22
*2N4058	0·20
*2N4059	0·15
*2N4060	0·20
*2N4061	0·17
*2N4062	0·18
*2N4124	0·17
*2N4126	0·17
*2N4286	0·20
*2N4288	0·25
*2N4289	0·25
*2N5457	0·35
*2N5458	0·35
*2N5459	0·35
3N125	1·75

INTEGRATED CIRCUITS

	£p
7400	0·20
7401	0·20
7402	0·20
7403	0·20
7404	0·26
7405	0·28
7406	0·55
7407	0·55
7408	0·28
7409	0·28
7410	0·20
7412	0·26
7413	0·45
7416	0·40
7417	0·40
7420	0·20
7422	0·25
7423	0·35
7425	0·35
7427	0·35
7428	0·50
7430	0·20
7432	0·36
7433	0·37
7437	0·42
7438	0·37
7440	0·22
7441AN	0·92
7442	0·78
7447AN	1·20
7450	0·20
7451	0·20
7453	0·20
7454	0·20
7460	0·20
7470	0·35
7472	0·36
7473	0·36
7474	0·40
7475	0·59
7476	0·42
7480	0·60
7482	0·85
7483	1·00
7484	1·00
7486	0·40
7490	0·52
7491AN	0·85
7492	0·60
7493	0·70
7494	0·80
7495	0·80
7496	0·90
7497	3·67
74100	1·75
74107	0·45
74109	0·86
74110	0·57
74111	0·86
74116	1·89
74118	0·95
74119	2·00
74120	1·10
74121	0·45
74122	0·60
74123	1·00
74125	0·80
74126	0·80
74128	0·80
74132	0·80
74136	0·68
74141	0·85
74142	3·00
74143	3·00
74144	3·00
74145	1·00
74147	2·45
74148	2·00
74150	1·75
74151	0·90
74154	2·00
74155	0·90
74156	0·90
74157	0·90
74159	2·50
74170	2·60
74172	5·00
74173	1·75
74174	1·57
74175	1·00
74176	1·10
74178	1·65
74179	1·65
74180	1·65
74190	1·48
74191	1·48
74192	1·25
74193	1·25
74194	1·25
74195	1·10
74196	1·20
74197	1·00
74198	2·25
74199	2·25
*76013N	1·75

Plugs in socket
—low profile

	£p
8 pin DIL	0·15
14 pin DIL	0·15
16 pin DIL	0·17

Open daily to callers: Mon.–Fri. 9 a.m.–5 p.m.
Valves, Tubes and Transistors · Closed Saturday
Terms C.W.O. only · Tel. 01-677 2424-7
Quotations for any types not listed S.A.E.
Post and Packing 25p per order +8% V.A.T.
Items marked * 12½%

Prices correct when going to press

NEW PRODUCTS · NEW PRODUCTS

POWER AMP KIT

The kit includes all metalwork, heatsinks and hardware to house any two of our power amp modules plus a power supply. It is contemporarily styled and its quality is consistent with tha of our other products. Comprehensive instructions and full back-up service enables a novice t build it with confidence in a few hours.

ADVANCED PRE-AMP CPR1

This stereo module accomplishes pre-amplification of disc and other inputs to an impeccable standard. The disc input has no common mode distortion effects, thd of .001%, 40dB overload 70dB s/n, and 6V/µS slew rate. Other inputs have 70mv sensitivity, thd of .001%, 90dB s/n 12dB/octave subsonic filter, 4V/µS slew rate and active balance control. Output is delayed fo 10 seconds. No controls are fitted.

MOVING COIL PRE-AMP MC1

This stereo module uses multiple input transistors to achieve 65dB s/n. Sensitivity is switched 70 or 160µV for 3.5mV output.

POWER SUPPLY

The regulator module, REG 1 provides 15-0-15v to power the CRP 1 and MC 1. It can be used with any of our power amp supplies or our small transformer TR 6. The power amp kit wil accommodate a REG 1.

POWER AMPLIFIER MODULES

CE 608 60W/8 ohms 35-0-35v	**£16.30**
CE 1004 100W/4 ohms 35-0-35v	**£19.22**
CE 1008 100W/8 ohms 45-0-45v	**£23.22**
CE 1704 170W/4 ohms 45-0-45v	**£29.12**
CE 1708 170W/8 ohms 60-0-60v	**£31.90**

TOROIDAL POWER SUPPLIES

CPS1 for 2×CE 608 or 1×CE 1004	**£14.47**
CPS2 for 2×CE 1004 or 2/4×CE 608	**£16.82**
CPS3 for 2×CE 1008 or 1×CE 1704	**£17.66**
CPS4 for 1×CE 1008	**£15.31**
CPS5 for 1×CE 1708	**£22.68**
CPS6 for 2×CE 1704 or 2×CE 1708	**£23.98**

HEATSINKS

Light duty, 50mm, 2°C/W	**£1.30**
Medium power, 100mm, 1.4°C/W	**£2.20**
Disco/group, 150mm, 1.1°C/W	**£2.85**
Fan, 80mm, state 120 or 240v	**£18.50**
Fan mounted on two drilled 100mm heatsinks, 2×.4°C/W, 65°C max with two 170W modules	**£29.16**

THERMAL CUT-OUT, 70°C **£1.90**

POWER AMP KIT **£32.40**

PRE-AMPS:

These are available in two versions – one uses standard components, and the other (the S) uses MO resistors where necessary and tantalum capacitors.

CPR1	**£29.49**	CPR1S	**£39.98**
MC1	**£18.50**	MC1S	**£29.49**

POWER SUPPLY:

REG1	**£6.75**	TR6	**£1.75**

BRIDGE DRIVER, BD1

Obtain up to 340W using 2 × 170W amps and this module.

BD1 .... **£5.40**

CRIMSON ELEKTRIK
1A STAMFORD STREET
LEICESTER LE1 6NL
Tel. (0533) 537722

All prices shown are UK only and include VAT and post. COD 90p extra, £100 limit. Export is n problem, please write for specific quote. Send large SAE or 3 International Reply Coupons fo detailed information. Distributor: Minic Teleprodukter, Box 12035, S-750 12 Uppsala 12, Swede

---

CHROMASONIC electronics

56 FORTIS GREEN ROAD, MUSWELL HILL, N10 3HN
TELEPHONE: 01-883 3705

OUR LATEST
CATALOGUE
CONTAINS **FREE**
45 pence WORTH
OF **VOUCHERS**

40p INC P.&P.

CONTAINS MICROPROCESSORS +BOARDS, MEMORIES, TTL, CMOS, ICs, PASSIVES, ETC., ETC.

SUPERSAVERS

ALL FULL SPEC DEVICES

TEXAS	TIMER	RED LED
741	**555**	**TIL209** (INC CLIP)
5 for	4 for	10 for
£1.00	**£1.00**	**£1.00**

VAT INCLUSIVE PRICE + 25p P. & P.

A4 IC BOOKLET

SUPPLIED **FREE** WITH ORDERS OF ANY ICs WORTH £5.00 OR MORE, CONTAINS CIRCUITS, PIN CONNECTIONS AND DATA (35p + SAE IF SOLD ALONE).

W & A

ELECTROTECHNICS LIMITED

465 CREWE ROAD, SANDBACH, CHESHIRE

SALE OF NEW AND GUARANTEED

UNUSED
INTEGRATED CIRCUITS SURPLUS TO OUR
REQUIREMENTS

ALL PRICES INCLUDE VAT, ADD 25p FOR P & P

DISCOUNTS

over £10 less 7½% over £20 less15%
over £50 less 20% CASH WITH ORDER

ABSOLUTELY UNBEATABLE PRICE TO CLEAR STORES

72709	**0.45**	74107	**0.25**	74283	**1.50**
74L00	**0.15**	74109	**0.39**	74284	**5.90**
74S02	**0.15**	74116	**1.20**	74285	**3.82**
7403	**0.09**	74128	**0.49**	74298	**1.50**
74L04	**0.16**	74S140	**0.69**	74366	**0.39**
7408	**0.11**	74150	**0.89**	74368	**0.39**
74H10	**0.19**	74151	**0.55**	74387	**0.90**
74S10	**0.15**	74S151	**0.95**	74S387	**1.90**
74S11	**0.15**	74153	**0.49**	74393	**1.89**
74H21	**0.25**	74155	**0.58**	75183	**0.35**
74H22	**0.22**	74S158	**0.49**	N8T37	**0.75**
7425	**0.18**	74164	**0.79**	N8T95	**0.85**
7426	**0.19**	74172	**3.50**	N8T96	**0.85**
7427	**0.19**	74S174	**0.99**	N8T97	**0.87**
74H28	**0.39**	74180	**0.79**	TIP125	**0.29**
74H74	**0.45**	74181	**1.55**	TMS6011	**4.90**
74S74	**0.29**	74191	**0.85**	A small number of Intel	
7475	**0.28**	74198	**1.25**	4004 µP products	
74LS86	**0.29**	74273	**1.75**	are available. SAE for	
74H87	**0.69**	74S280	**2.90**	list.	

New from Mantec

A comprehensive Home Study Course in Electronics

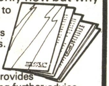
Suitable for Beginners and Students

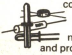
The Course which gives you "Right from the Start" the practical experience as well as the all important back-up theory.

Suitable preparation for C and G examinations

Ensure your future in tomorrow's technology

The home study course that tells not only how but why





The Course includes:- 1 The Manual. Easy to read and understand, set out in a clear and concise way, includes numerous experiments and diagrams.
2 The Kit. All components necessary for the experiments and projects covered. Mantec also provides a tutorial support service for students requiring further advice.

Send today for your "Right from the start" Home Study Course. Price £35.00 including VAT.

Fill in the coupon Now!

Mantec the leaders in Manufacturing Technology

Mantec, 7 Dellsome Lane, Welham Green, Hatfield, Herts.

To: Mantec, 7 Dellsome Lane, Welham Green,
Hatfield, Herts.

Please send me. . . . . "Right from the Start" home study course(s).

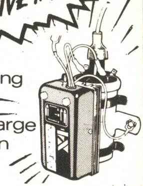
I enclose Cheque/Postal Order for £ . . . .

Name: ______________________________

Address: ____________________________

The latest kit innovation! from Sparkrite

Sparkrite- was featured by Shaw Taylor in "DRIVE IN"



the quickest fitting

CLIP ON

capacitive discharge
electronic ignition
in KIT FORM

- **Smoother running**
- **Instant all-weather starting**
- **Continual peak performance**
- **Longer coil/battery/plug life**
- **Improved acceleration/top speeds**
- **Optimum fuel consumption**

Sparkrite X4 is a high performance, high quality capacitive discharge, electronic ignition system in kit form. Tried, tested, proven, reliable and complete. It can be assembled in two or three hours and fitted in 1/3 mins.

Because of the superb design of the Sparkrite circuit it completely eliminates problems of the contact breaker. There is no misfire due to contact breaker bounce which is eliminated electronically by a pulse suppression circuit which prevents the unit firing if the points bounce open at high R.P.M. Contact breaker burn is eliminated by reducing the current to about 1/50th of the norm. It will perform equally well with new, old, or even badly pitted points and is not dependent upon the dwell time of the contact breakers for recharging the system. Sparkrite incorporates a short circuit protected inverter which eliminates the problems of SCR lock on and, therefore, eliminates the possibility of blowing the transistors or the SCR. (Most capacitive discharge ignitions are not completely foolproof in this respect). The circuit incorporates a voltage regulated output for greatly improved cold starting. The circuit includes built in static timing light, systems function light, and security changeover switch. All kits fit vehicles with coil/distributor ignition up to 8 cylinders.

THE KIT COMPRISES EVERYTHING NEEDED

Die pressed epoxy coated case. Ready drilled, aluminium extruded base and heat sink, coil mounting clips, and accessories. Top quality 5 year guaranteed transformer and components, cables, connectors, P.C.B., nuts, bolts and silicon grease. Full instructions to assemble kit neg. or pos. earth and fully illustrated installation instructions.

NOTE—Vehicles with current impulse tachometers (Smiths code on dial Rv1) will require a tachometer pulse slave unit. Price £3.35 inc. VAT. post & packing.

Electronics Design Associates, Dept. PE10, 82 Bath Street, Walsall, WS1 3DE. Phone: (9) 614791

Electronics Design Associates, Dept. PE11
82 Bath Street, Walsall, WS1 3DE. Phone: (9) 614791

Name . . . .

Address . . . .

Phone your order with Access or Barclaycard

Inc. V.A.T. and P.P.	QUANTITY REQ'D.
X4 KIT **£14·95**	
TACHS PULSE SLAVE UNIT **£3.35**	

Send SAE if brochure only required.

I enclose cheque/PO's for

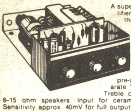
£ ______________

Cheque No.

Please state polarity pos or neg earth.

Access or Barclaycard No. ________________________

SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz 30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume. Bass boost and Treble cut controls. Suitable for 8–15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3in high × 6in wide × 7½in deep. AC 200/250V.

PRICE **£15·00** P. & P. £1·20.

HARVERSONIC MODEL P.A. TWO ZERO

An advanced solid state general purpose mono amplifier suitable for Public Address system, Disco, Guitar, Gram., etc. Features 3 individually controlled inputs (each input has a separate 2 stage pre-amp.). Input 1, 15mV into 47k. Input 2, 15mV into 47k (suitable for use with mic. or guitar etc.). Input 3, 200mV into 1 meg. suitable for gram, tuner, or tape etc. Full mixing facilities with full range bass & treble controls. All inputs plug into standard jack sockets on front panel. Output socket on rear of chassis for an 8 ohm or 16 ohm speaker. Output in excess of 20 watts R.M.S. Very attractively finished purpose built cabinet made from black vinyl covered steel, with a brushed anodised aluminium front escutcheon. For ac mains operation 200/240 volts. Size approx. 12¼in. wide × 5in high × 7¼in deep.

Special introductory price **£28·00** + £2·50 carriage and packing.

Mullard LP1159 RF-IF module 470 kHz **£2·25** + P & P 20p. Full specification and connection details supplied.

Pye VHF FM Tuner Head covering 88-108 MHz 10·7 MHz I.F. output. 7-8V + earth. Supplied pre-aligned, with full circuit diagram with precision-geared F.M. gang and 323PF + 323PF A.M. Tuning gang only **£3·15** + P. & P. 35p.

STILL AVAILABLE

HA34 3 Valve Audio Amp. 4½w o/p. Ready built and tested **£8.50** + £1.40 P. & P.

Also HSL 'Four' Amp. Similar to above but in kit form. **£8.00** + £1.40 P. & P.

MAINS OPERATED SOLID STATE AM/FM STEREO TUNER

200/240V Mains operated Solid State F.M. A.M. Stereo Tuner. Covering M.W. A.M. 540–1605KHz V.H.F. F.M. 88–108MHz.

Built-in Ferrite rod aerial for M.W. Full AFC and AGC on A.M. and F.M. Stereo Beacon Lamp Indicator. Built in Pre-amps with variable output voltage adjustable by pre-set control. Max o/p Voltage 600mV R.M.S. into 20K. Simulated Teak finish cabinet. Will match almost any amplifier. Size 8¼in wide × 4in high × 9½in deep approx.

Limited number only at £28·00 + £1·50 P. & P.

MAINS TRANSFORMER. PRI. 0·110 and 240. SEC. 28V at 1·8 amps. Also tapped at 12V ·3 amp. Overall size 2¾"h x 3¼"w x 2¾"d. **£2·50** + P&P £1·00.

·10/14 WATT HI-FI AMPLIFIER KIT

A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up. 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet **25p** + S.A.E. (Free with parts). All parts sold separately. ONLY **£14·50** P. & P. £1·40. Also available ready built and tested **£19·00** P. & P. £1·40.

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER

Size 11¾in × 14$\frac{11}{16}$in × 1$\frac{7}{16}$in deep. Weight 19oz. Power handling 20W R.M.S. (40W peak). Impedance 8 ohm only. Response 40Hz-20KHz. Can be mounted on ceilings, walls, doors, under tables, etc, and used with or without baffle. Send S.A.E. for full details. Only **£8·40** each + P. & P. (one **90p**, two **£1·10**). Now available in either 8in round version or 4½ × 8½in rectangular. 10 watts R.M.S. 60Hz-20KHz **£5·25** + P. & P. (one **65p**, two **75p**.).

MAGNETIC PRE-AMP Sens. 3mV in for 100mV out. 15 to 35V neg. earth. Equ. ±1dB from 20Hz to 20KHz. Input impedance 47K. Size 1⅝in × 2⅜in × 5⅝in H. **£2·60** +20p. P & P.

2in **PLASTIC CONE HF TWEETER** 4 ohm, **£3.50** per matched pair + 50p P. & P.

HIGH POWER HI-FI 8 ohm Dome Tweeter. 1in voice coil. Magnet size 3in dia. Suitable for use in up to 50 watt systems. **£4.50** each 60p P. & P.

HARVERSONIC SUPERSOUND 10 + 10 STEREO AMPLIFIER KIT

A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integral pre-amp with Bass, Treble and two Volume controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metalwork, high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Power output: 14 watts R.M.S. per channel into 5 ohms. Frequency response ±3dB 12–30,000Hz. Sensitivity better than 80mV into 1 MΩ. Full power bandwidth ±3dB 12–15,000Hz. Bass boost approx. to ±12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 35V at 1A.

Overall size 12in wide × 8in deep × 2¾in high.

Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E.

AMPLIFIER KIT (Magnetic input components 33p extra)	£13·50	P. & P. 80p
POWER PACK KIT	£5·50	P. & P. 95p
CABINET	£5·50	P. & P. 95p

SPECIAL OFFER—only £23·75 if all 3 items ordered at one time plus £1·25 P. & P.

Full after sales service

Also available ready built and tested **£31·25** P. & P. £1·50

HARVERSONIC STEREO 44

A solid state stereo amplifier chassis, with an output of 3–4 watts per channel into 8 ohm speakers. Using the latest high technology integrated circuit amplifiers with built in short term thermal overload protection. All components including rectifier smoothing capacitor, fuse, tone control, volume controls, 2 pin din speaker sockets and 5 pin din tape rec./play socket are mounted on the printed circuit panel. Size approx. 9⅛in × 2¼in × 1in max. depth. Supplied brand new and tested, with knobs, brushed anodised aluminium 2 way escutcheon (to allow the amplifier to be mounted horizontally or vertically) at only **£9·00** + 50p & P. Mains transformer with an output of 17V a.c. at 500m/A be supplied at **£1·50** + 40p P. & P. if required. Full co .ction details supplied.

STEREO DECODER

SIZE 2" · 3" · ½" ready built. Pre-aligned and tested for 9-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions (inclusive of hints and tips) supplied. **£6·00** plus 20p P. & P. Stereo beacon light if required **40p** extra.

Open 9.30–5.30 Monday to Friday. 9.30–5 Saturday Closed Wednesday.

Prices and specifications correct at time of press. Subject to alteration without notice

HARVERSON SURPLUS CO. LTD.

(Dept. P.E.) 170 MERTON HIGH ST., MERTON, LONDON, S.W.19 Tel: 01-540 3985

A few minutes from South Wimbledon Tube Station

(Please write clearly)

PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

SINCLAIR PRODUCTS*

Microvision TV £200. PDM35 £27-25. Mains adaptor £3-24. Case £3-25. 30kV probe £18-95. DM235 £47-50. Rechargeable battery units £7-95. Adaptor/charger £3-70. Case £8-50. 30kV probe £18-95. Cambridge prog. calculator £13-15. Prog. library £2-95. Mains adaptor £3-20.

S-DECS AND T-DECS*

S-DeC £3-39. T-DeC £4-44. u-DeCA £4-52. u-DeCB £6-73. 16 dil or 10TO5 adaptors with sockets £2-14.

CONTINENTAL SPECIALITIES PRODUCTS*

EXP300 £6-21. EXP350 £3-40. EXP600 £6-80. EXP650 £3-89. EXP4B £2-48. PB6 £9-94. PB100 £12-74. LM1 £30-99. LP1 £33-48. LP2 £19-44.

TV GAMES

Send sae for free data. New racing car TV games chip AY-3-8603 plus economy kit £20-60. Tank battle chip AY-3-8710 plus economy kit £13-95. Stunt motor cycle chip AY-3-8760-1 plus economy kit £12-50. 10 game paddle 2 chip AY-3-8600 plus economy kit £12-50. AY-3-8500 chip plus economy kit £8-95. Modified shoot kit £4-96. Rifle kit £4-95. Colour generator kit £7-50. Attractively cased, assembled TV games:– stunt cycle £25-95, tank war game £39-95, 4 game models (tennis, football, squash, pelota):– black and white £11-95, colour £14-50. De-luxe 6 game b/w model with pistol attachment £17-95.

MAINS TRANSFORMERS

6-0-6V 100ma 79p, 1½A £2-35. 6.3V 1½A £1-89. 9-0-9V 75ma 79p, 1A £1-99, 2A £2-60. 12-0-12V 50ma 79p, 100ma 90p, 1A £2-49. 13V ½A 95p. 15-0-15V 1A £2-79. 30-0-30V 1A £3-59.

JC12, JC20 AND JC40 AMPLIFIERS

A range of integrated circuit audio amplifiers supplied with free data and printed circuits. JC12 6 watts £1-60. JC20 10 watts £2-95. JC40 20 watts £3-95. Send sae for free data on our range of matching power and preamp kits.

FERRANTI ZN414

IC radio chip £1-05. Extra parts and pcb for radio £3-85. Case £1. Send sae for free data.

PRINTED CIRCUIT MATERIALS

PC etching kits:– economy £1-70, standard £3-82. 50 sq ins pcb 40p. 1 lb FeCl £1-05. Etch resist pens:– economy 45p, dalo 73p. Small drill bits $\frac{1}{32}$ ins or 1 mm 20p each. Etching dish 68p. Laminate cutter 75p.

BATTERY ELIMINATORS

3-way models with switched output and 4 way multi-jack:– 3/4½/6V 100ma £2-51. 6/7½/9V 300ma £2-75. **100ma radio models** same size as a PP9 battery with press stud connectors. 9V £2-85. 6V £2-85. 4½V £2-85. 9V+9V £4-50. 6V+6V £4-50. 4½V+4½V £4-50. **cassette recorder mains unit** 7½V 100ma with 5 pin din plug £2-85. **car convertors** 12V dc input. Output 9V 300ma £1-50. Output 7½V 300ma £1-50. Output 3/4½/6/7½/]/12V 800ma £2-50.

BATTERY ELIMINATOR KITS

Send sae for free leaflet on range. **100ma radio types** with press stud connectors. 4½V £1-80. 6V £1-80. 9V £1-80. 4½+4½V £2-50. 6+6V £2-50. 9+9V £2-50. **cassette type** 7½V 100ma with din plug £1-80. **heavy-duty 13 way types** 4½/6/7/8½/11/13/14/17/21/25/28/34/42V. 1 Amp £4-65. 2 Amp £7-25. **transistor stabilized 8-way types** for low hum 3/4½/6/7½/9/12/15/18V 100ma £3-20. 1 Amp £6-40. **variable voltage stabilized** models. 2-18V 100ma £3-60. 2-30V 1A £6-95. 2-30V 2A £10-95. **car convertors** 12V dc input. Output 9/7½/6V 1 Amp stabilized £1-95.

BI-PAK AUDIO MODULES

Send sae for data. S450 tuner £23-51. AL60 £4-86. PA100 £16-71. SPM80 £4-47. BMT80 £5-95. MK60 £38-74. Stereo 30 £20-12.

BULK BUY OFFERS

Minimum purchase £3 any mix from this section. IN4148 1.3p. IN4002 3.6p BC212 8p. 741 8 dil 15p. NE555 8 dil 23p. 723 14 dil 43p. AC76023N exact equiv. of SN76023N with improved heat sink 79p. Plastic equivs. of popular transistors:– BC109 4.4p, BCY71 4.7p, BCY72 4.4p. **fuses** 20 mm x 5 mm cartridge .25, .5, 1, 2, 3, 5 Amp. Quickblow type 0.7p. Antisurge type 3.4p. **resistors** 5% E12 10 ohm to 10M. ¼W 0.9p. 1W 1.9p. **polyester capacitors** 250V .01, .022, .033, .047mf 2.7p. .015mf 1.1p, .068mf 1.4p, 0.1mf 1.5p, 0.22mf 3p, 0.33mf 2.5p, 0.47mf 4.8p. **polystyrene capacitors** E12 63V 15 to 6800pf 2½p. **ceramic capacitors** 50V E12 22pf to 1000pf 1.7p. E6 1500 to 33000pf 1.7p. 47000pf 2p. **electrolytics 50V** .47, 1, 2mf 5p. 25V 5mf 5p. 10mf 4p. **16V** 22mf 5p. 33, 47. 100mf 6p. 220, 330mf 9p. 470mf 11p. 1000mf 12p. **zeners** 400mW E24 2V7 to 33V 6.1p. **preset pots** sub miniature 0.1W horiz. or vert. 100 to 4M7 6.8p. **potentiometers** ¼W 4K7 to 2M2 log or lin. single 26p. dual 76p.

SWANLEY ELECTRONICS

DEPT. P.E., 32 Goldsel Rd., Swanley, Kent BR8 8EZ

Mail order and callers by appointment only. Please add 30p to the total cost of order for postage. Prices include VAT. Overseas customers deduct 7% on items marked * and 11% on others. Official credit orders welcome.

---

110 WAVEFORM GENERATOR PROJECTS FOR THE HOME CONSTRUCTOR

R. M. Marston

Many electronic devices, from simple alarm generators to complex test equipment, are based on waveform generators. This addition to the popular series for projects builders shows 110 waveform-generator circuits with a variety of applications of interest to the electronics amateur, student and engineer. All the circuits have been designed, built and fully evaluated by the author. The book includes design charts for readers wishing to design or modify waveform generators to their own specifications.

1978 144 pages 216 x 138 mm Illustrated 0 408 00353 7
Paperback £2.95 US $6.00

By the same author

110 INTEGRATED CIRCUIT PROJECTS FOR THE HOME CONSTRUCTOR – Second Edition

R. M. Marston

1978 128 pages 216 x 138 mm Illustrated 0 408 00309 X
Paperback £2.95 US $6.00

110 SEMICONDUCTOR PROJECTS FOR THE HOME CONSTRUCTOR – Second Edition

R. M. Marston

1978 128 pages 216 x 138 mm Illustrated 0 408 00322 7
Paperback £2.85 US $5.75

NEWNES TECHNICAL BOOKS

Borough Green, Sevenoaks, Kent TN15 8PH
Telephone: (0732) 884567

Marshall's

Come and get a great deal

Call in and see us 9-5.30 Mon-Fri 9-5.00 Sat
Express Mail Order Tel. orders on credit cards £10 min.
Trade and export enquiries welcome

A. Marshall (London) Ltd, Dept. PE. Head Office mail order: Kingsgate House, Kingsgate Place, NW6 4TA. Tel: 01-624 0805. **Retail Sales London:** 40-42 Cricklewood Bdwy, NW2 3ET. Tel: 01-452 0161/2. Telex: 21492. **London:** 325 Edgware Rd, W2. Tel: 01-723 4242. **Glasgow:** 85 West Regent St, G2 2QD. Tel: 041-332 4133. **Bristol:** 1 Straits Pde, Fishponds Rd, BS16 2LX. Tel: 0272 654201.

N696	0.39	2N2219	0.38	2N3397	0.19	2N4062	0.20	2N5247	0.44	40410	0.82					BC214B	0.17	BC549B	0.14	BD244A	0.70	BF182	0.37	BFX89	1.37	MJE520	0.50
N697	0.31	2N2219A	0.39	2N3438	0.85	2N4064	1.35	2N5248	0.44	40411	3.10					BC214C	0.17	BC549C	0.15	BD244C	0.87	BF183	0.44	BFY50	0.27	MJE521	0.70
N698	0.49	2N2220	0.39	2N3440	0.75	2N4074	2.65	2N5294	0.44	40594	0.87	BC147	0.13	BC182B	0.13	BC214L	0.18	BC557	0.14	BD245A	0.69	BF184	0.41	BFY51	0.27	MJE2955	1.65
N699	0.58	2N2221	0.25	2N3441	0.92	2N4121	0.27	2N5295	0.44	40595	0.98	BC147B	0.13	BC182L	0.15	BC214LB	0.18	BC558	0.13	BD245C	0.85	BF185	0.37	BFY52	0.27	MPF3055	1.05
N706	0.30	2N2221A	0.25	2N3442	1.45	2N4122	0.27	2N5296	0.44	40673	0.80	BC148	0.13	BC182LA	0.15	BC214LC	0.18	BC559	0.15	BD246A	0.72	BF194	0.16	BFY90	1.35	MPF102	0.33
N706A	0.30	2N2222	0.25	2N3638	0.17	2N4123	0.19	2N5298	0.44	40669	1.30	BC148B	0.13	BC182LB	0.15	BC237B	0.15	BCY70	0.21	BD246C	0.93	BF195	0.16	BR101	0.55	MPF103	0.44
N708	0.30	2N2222A	0.25	2N3638A	0.17	2N4124	0.19	2N5447	0.16	AC126	0.48	BC148C	0.13	BC183	0.12	BC238A	0.13	BCY71	0.26	BD433	0.44	BF196	0.16	BRY39	0.55	MPF104	0.44
N718	0.30	2N2369	0.27	2N3702	0.14	2N4125	0.19	2N5448	0.16	AC127	0.48	BC149	0.15	BC183A	0.12	BC238B	0.13	BCY72	0.18	BD434	0.46	BF197	0.18	BSX19	0.35	MPS105	0.44
N718A	0.54	2N2369A	0.27	2N3703	0.14	2N4126	0.19	2N5449	0.20	AC128	0.48	BC149C	0.15	BC183B	0.13	BC238C	0.13	BD115	0.88	BD435	0.46	BF198	0.19	BSX20	0.35	MPSA05	0.27
N720A	0.85	2N2646	0.80	2N3704	0.14	2N4284	0.38	2N5457	0.38	AC151	0.43	BC157A	0.15	BC183C	0.13	BC239B	0.16	BD131	0.55	BD436	0.46	BF199	0.19	BSX21	0.35	MPSA06	0.27
N722	0.45	2N2647	1.55	2N3705	0.14	2N4286	0.22	2N5458	0.35	AC152	0.54	BC158A	0.15	BC183L	0.15	BC239C	0.17	BD132	0.75	BD437	0.55	BF224J	0.22	BU104	1.80	MPSA12	0.44
N727	0.50	2N2903	1.60	2N3706	0.14	2N4287	0.22	2N5459	0.32	AC153	0.59	BC158B	0.15	BC183LA	0.15	BC257A	0.18	BD135	0.40	BD438	0.55	BF225J	0.27	BU105	1.55	MPSA14	0.33
N914	0.38	2N2904	0.31	2N3707	0.14	2N4288	0.22	2N5460	0.65	AC153K	0.59	BC159A	0.17	BC183LB	0.15	BC258B	0.19	BD136	0.40	BD529	0.49	BF244A	0.38	BU126	1.08	MPSA55	0.27
N916	0.33	2N2904A	0.31	2N3708	0.12	2N4289	0.22	2N5484	0.37	AC176K	0.70	BC159B	0.17	BC183LC	0.15	BC259B	0.19	BD137	0.41	BD530	0.55	BF244B	0.33	BU204	2.20	MPSA56	0.27
N917	0.38	2N2905	0.31	2N3709	0.12	2N4347	2.20	2N5485	0.40	AC176	0.54	BC160	0.38	BC184	0.12	BC300	0.43	BD138	0.41	BD535	0.70	BF245A	0.44	BU205	2.40	R2008B	2.45
N918	0.45	2N2905A	0.31	2N3771	2.16	2N4348	2.65	2N5486	0.40	AC187	0.59	BC161	0.38	BC184B	0.13	BC301	0.43	BD139	0.43	BD536	0.70	BF245B	0.44	BU206	2.70	R2010B	2.15
N929	0.37	2N2906	0.25	2N3772	2.20	2N4918	0.65	2N5490	0.64	AC187K	0.65	BC167	0.13	BC184C	0.13	BC302	0.37	BD140	0.43	BD537	0.74	BF257	0.35	BU208	2.70	TIP29A	0.49
N929A	0.37	2N2906A	0.25	2N3773	3.15	2N4919	0.70	2N5492	0.64	AC188	0.54	BC167B	0.13	BC184L	0.15	BC303	0.54	BD181	1.90	BD538	0.77	BF258	0.35	ME0401	0.22	TIP29C	0.65
N930	0.37	2N2907	0.25	2N3819	0.36	2N4920	0.83	2N5494	0.65	AC188K	0.65	BC168A	0.13	BC184LB	0.15	BC307	0.16	BD182	2.20	BD539	0.60	BF259	0.35	ME0402	0.22	TIP30A	0.54
N930A	0.95	2N2907A	0.25	2N3820	0.39	2N4921	0.54	2N5496	0.67	AD161	1.00	BC168B	0.13	BC184LC	0.15	BC307A	0.16	BD183	2.35	BD540	0.60	BF336	0.42	ME0404	0.17	TIP30C	0.70
N1711	0.30	2N2923	0.17	2N3821	0.96	2N4922	0.60	2N6027	0.64	AD162	1.00	BC168C	0.13	BC212	0.15	BC307B	0.16	BD187	0.95	BDX14	1.32	BF337	0.49	ME0412	0.22	TIP31A	0.54
N1889	0.30	2N2924	0.17	2N3900	0.28	2N4923	0.75	2N6107	0.45	AF106	0.60	BC169B	0.13	BC212A	0.15	BC308	0.16	BD235	0.46	BDX18	1.90	BF338	0.52	ME0414	0.22	TIP31C	0.72
N1890	0.30	2N2925	0.19	2N3901	0.30	2N4924	1.15	2N6108	0.55	AF109	0.52	BC169C	0.13	BC212B	0.15	BC308B	0.16	BD236	0.44	BDY20	1.10	BFR39	0.30	ME4001	0.16	TIP32A	0.59
N1893	0.30	2N2926	0.17	2N3903	0.20	2N5086	0.30	2N6109	0.55	BC107	0.16	BC177	0.22	BC212L	0.18	BC309A	0.16	BD237	0.44	BDY55	1.90	BFR40	0.29	ME4002	0.16	TIP32C	0.82
N2102	0.50	2N3053	0.25	2N3904	0.18	2N5087	0.30	2N6111	0.49	BC107A	0.16	BC177A	0.22	BC212LA	0.18	BC309B	0.16	BD238	0.44	BDY56	2.10	BFR41	0.30	ME4003	0.16	TIP41A	0.76
N2192	0.58	2N3054	0.72	2N3905	0.18	2N5088	0.30	2N6121	0.41	BC107B	0.16	BC177B	0.25	BC212LB	0.18	BC309C	0.16	BD239A	0.44	BF115	0.39	BFR79	0.30	ME4101	0.11	TIP41C	0.97
N2193	0.50	2N3055	0.75	2N3906	0.18	2N5089	0.30	2N6122	0.44	BC108	0.16	BC178	0.22	BC213	0.15	BC327	0.22	BD239C	0.59	BF160	0.33	BFR80	0.30	ME4102	0.11	TIP42A	0.86
N2193A	0.52	2N3390	0.50	2N4031	0.55	2N5190	0.65	2N6123	0.48	BC108A	0.16	BC178A	0.25	BC213A	0.15	BC328	0.20	BD240A	0.49	BF161	0.65	BFR81	0.30	ME4103	0.11	TIP42C	1.08
N2194	0.42	2N3391	0.40	2N4032	0.65	2N5191	0.75	2N6124	0.45	BC108B	0.16	BC178B	0.35	BC213B	0.15	BC337	0.20	BD240C	0.59	BF167	0.37	BFX29	0.34	ME4104	0.11	TIP2955	0.70
N2194A	0.45	2N3391A	0.45	2N4036	0.72	2N5192	0.80	2N6125	0.47	BC108C	0.17	BC179	0.25	BC213C	0.15	BC338	0.23	BD241A	0.49	BF173	0.37	BFX30	0.34	ME6101	0.22	TIP3055	0.59
N2195	0.40	2N3392	0.17	2N4037	0.60	2N5193	0.75	40361	0.55	BC109	0.16	BC179A	0.25	BC213L	0.17	BC547	0.13	BD241C	0.65	BF177	0.27	BFX84	0.30	ME6102	0.22	TIS34	1.05
N2195A	0.40	2N3393	0.17	2N4058	0.22	2N5194	0.80	40362	0.55	BC109B	0.17	BC179B	0.25	BC213LA	0.17	BC547A	0.13	BD242A	0.55	BF178	0.27	BFX85	0.38	MJ2955	1.35	TIS42	0.50
N2217	0.55	2N3394	0.17	2N4059	0.17	2N5195	0.97	40363	1.45	BC109C	0.18	BC179C	0.26	BC213LB	0.17	BC547B	0.13	BD242C	0.62	BF179	0.33	BFX86	0.30	MJE340	0.62	TIS43	0.47
N2218	0.35	2N3395	0.19	2N4060	0.22	2N5245	0.37	40408	0.82	BC140	0.30	BC182	0.12	BC213LC	0.17	BC548	0.13	BD243A	0.65	BF180	0.37	BFX87	0.35	MJE370	0.62	TIS90	0.22
N2218A	0.38	2N3396	0.19	2N4061	0.19	2N5246	0.38	40409	0.82	BC141	0.32	BC182A	0.12	BC214	0.17	BC549	0.14	BD243C	0.87	BF181	0.37	BFX88	0.30	MJE371	0.86	TIS91	0.27

LINEAR CIRCUITS

CA3018	0.75	LM379S	4.25	LM324	0.75	TAA930B	1.45
CA3018A	1.10	LM380N8	0.96	LM7815K	1.75	TAD100	2.00
CA3020	2.20	LM380N14		LM7824K	1.75	TBA120	0.80
CA3020A	2.50		1.08	LM78L05CZ		TBA500	2.24
CA3028A	0.90	LM381AN	2.70		0.30	TBA500Q	2.34
CA3028B	1.25	LM381N	1.69	LM78L12CZ		TBA510	2.35
CA3030	1.50	LM382N	1.32		0.30	TBA510Q	2.48
CA3030A	2.20	LM384N	1.55	LM78L15CZ		TBA520	2.60
CA3038	2.90	LM386N	0.88		0.30	TBA520Q	2.70
CA3038A	4.10	LM387N	1.10	MM5314	4.60	TBA530	2.35
CA3045	1.55	LM388N	1.00	MM5316	4.60	TBA530Q	2.45
CA3046	0.77	LM389N	1.00	NE555	0.33	TBA540	2.60
CA3048	2.45	LM702C	0.81	NE556	0.85	TBA540Q	2.70
CA3052	1.78	LM709	0.70	NE558N	1.98	TBA550	3.60
CA3080	0.85	LM7098	0.50	NE560	4.50	TBA550Q	3.80
CA3080A	2.10	LM70914	0.49	NE561	4.50	TBA5600Q	3.00
CA3086	0.50	LM710	0.67	NE562	4.50	TBA570	2.10
CA3088B	1.87	LM71014	0.64	NE565	1.39	TBA570Q	2.20
CA3089B	2.90	LM711CN	0.72	NE566	1.75	TBA700Q	2.20
CA3090Q	4.40	LM723C	0.75	NE567	1.90	TBA720AQ	2.06
CA3130	1.06	LM723C14	0.45	NE571N	4.95	TBA750	2.36
CA3140	1.04	LM726	5.80	SAS560	2.70	TBA750Q	2.45
LM301	0.30	LM741C	0.70	SAS570	2.70	TBA800	1.30
LM307N	0.50	LM741C8	0.30	SAJ110	2.10	TBA810S	1.30
LM308N	0.95	LM741C14	0.30	S041P	1.35	TBA820	0.80
LM309KC	1.95	LM747CN	0.99	S042P	1.35	TBA920	2.99
LM317K	3.35	LM7488	0.50	SN76001N		TCA160C	2.36
LM318N	2.45	LM74814	0.90		1.30	TCA160B	2.55
LM320TS	2.15	LM1303N	1.15	SN76003N		TCA270	2.99
LM320T12	2.15	LM1304N	1.52		2.38	TCA730	4.50
LM320T15	2.15	LM1305N	1.52	SN76013N		TCA740	4.50
LM320T24	2.15	LM1307N	1.22		1.50	TCA750	3.00
LM320P5	1.15	LM1310N	2.10	SN76023N		TCA760	2.00
LM320P12	1.15	LM1351N	1.30		1.50	TCA105	1.49
LM320P15	1.15	LM1458N	0.45	SN76033N		TCA440	1.65
LM320P24	1.15	LM1496N	0.97		2.35	TDA1022	7.50
LM323K	6.95	LM1808N	2.10	TAA263	1.35	TDA1024	1.24
LM339N	0.60	LM1812N	6.20	TAA300	3.70	TDA1034	4.75
LM340T5	0.88	LM1820N	1.16	TAA320A	1.15	TDA2020AD	
LM340T15	0.88	LM1828N	1.90	TAA350A	3.00		4.50
LM340T24	0.88	LM1830N	1.90	TAA521	1.10	UAA170	2.15
LM341P5	0.80	LM1841N	1.90	TAA522	2.10	UAA180	2.15
LM341P12	0.80	LM1845N	1.50	TAA550	0.48	TL080CP	1.25
LM341P15	0.80	LM1848N	1.98	TAA560	2.10	TL081CP	0.90
LM341P24	0.80	LM1850N	1.90	TAA570	2.20	TL082CP	1.10
LM348N	0.95	LM1889N	4.90	TAA370A	5.45	TL083CN	1.40
LM358N	0.60	LM3301N	0.60	TAA630	2.40	TL084CN	1.45
LM360N	3.00	LM3302N	0.55	TAA960	3.90	LF355N	0.80
LM370N	3.30	LM3401N	0.55	TAA970	4.20	LF356N	0.80
LM371H	2.35	LM3900N	0.68	TAA611B	2.50	LF357N	0.80
LM350K	6.45	LM3905N	1.15	TAA621	2.50	LF13201N	3.00
LM373N	3.35	LM3909N	0.78	TAA661A	1.65	LF13331N	3.00
LM374N	3.36	LM3911N	1.10	TAA661B	1.45	LF13741H	0.80
LM377N	1.80	LM7805K	1.75	TAA700	4.50	LF13741N	0.55
LM378N	2.40	LM7812K	1.75	TAA930A	1.45		

EXPAND AND GROW WITH KIM

NOT A KIT BUT A READY TO USE MICROCOMPUTER SYSTEM

AMERICA'S FASTEST SELLING MOST POPULAR 6502 BASED SYSTEM – EASILY EXPANDED INTO A PERSONAL HOME COMPUTER

The basic KIM 2 includes Hex keyboard and display, audio cassette interface. VDU interface. Superb documentation. 2K monitor software in ROM. Powerful instruction set. The beauty of this system is the ease of extension and versatility with all the possible future requirements catered for. Up and running in minutes. Any future benefits from Commodores **PET** computer will be software compatible with their KIM system and in fact your KIM system has the design flexibility to suit any requirements.

KIM IS EXPANDABLE – Expand as you learn up to 65K

KIM 1 – Basic board with above features assembled	£160.92
KIM 3 – 8K static RAM card plugs into motherboard	£193.00
KIM 4 – Motherboard (takes 6 x KIM 3) + power supply	£96.00
KIM 6 – Prototype board for user designation	£42.00

The Commodore PET and KIM are both based on the 6502 micro

VDU INTERFACE – VDU card — takes control	£150.00

Fully assembled TTY Card – ASC II keyboard in – converts TV set to cheap computer terminal via aerial socket. Also standard RS232 connector for micro computer or modem – 16 lines x 64 characters

SEND SAE NOW FOR FULL DETAILS.

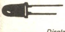
TTL

74LS00N	0.26	74LS162N	1.43	7400N	0.17	7490AN	0.45
74LS01N	0.26	74LS164N	1.43	7401N	0.17	7491AN	0.85
74LS02N	0.26	74LS168N	2.43	7402N	0.17	7492N	0.45
74LS03N	0.26	74LS169N	2.43	7403N	0.17	7493N	0.45
74LS04N	0.29	74LS174N	1.33	7404N	0.17	7494N	0.90
74LS10N	0.26	74LS175N	1.26	7405N	0.22	7495N	0.76
74LS12N	0.26	74LS181N	3.95	7406N	0.56	7496N	0.70
74LS13N	0.58	74LS189N	3.74	7407N	0.55	7497N	1.95
74LS14N	1.43	74LS190N	1.00	7408N	0.22	74100N	1.40
74LS20N	0.26	74LS191N	1.00	7409N	0.22	74107N	0.35
74LS26N	0.39	74LS192N	1.98	7410N	0.20	74118N	0.95
74LS27N	0.50	74LS193N	1.98	7411N	0.26	74119N	1.40
74LS28N	0.42	74LS196N	1.28	7412N	0.20	74121N	0.28
74LS30N	0.26	74C00N	0.24	7413N	0.36	74122N	0.55
74LS37N	0.32	74C02N	0.24	7414N	0.80	74123N	0.55
74LS38N	0.32	74C04N	0.24	7416N	0.36	74125N	0.45
74LS40N	0.29	74C08N	0.24	7417N	0.36	74141N	0.86
74LS42N	1.07	74C10N	0.24	7420N	0.22	74148N	1.35
74LS47N	1.09	74C14N	1.41	7423N	0.32	74145N	0.86
74LS48N	1.09	74C20N	0.24	7425N	0.32	74150N	1.20
74LS49N	1.09	74C30N	0.24	7427N	0.32	74151N	0.76
74LS51N	0.26	74C32N	0.24	7430N	0.22	74153N	0.76
74LS54N	0.26	74C42N	0.92	7432N	0.30	74154N	1.20
74LS73N	0.42	74C48N	1.38	7437N	0.35	74155N	0.70
74LS76N	0.42	74C73N	0.54	7438N	0.32	74157N	0.78
74LS78N	0.42	74C74N	0.56	7440N	0.20	74160AN	1.10
74LS83AN	1.20	74C76N	0.54	7441AN	0.84	74161AN	1.10
74LS85N	1.10	74C83N	1.30	7442N	0.76	74162AN	1.10
74LS90N	1.10	74C85N	1.30	7445N	1.40	74163AN	1.10
74LS91N	1.20	74C86N	0.64	7446AN	0.90	74164N	1.36
74LS92N	0.86	74C89N	4.39	7447AN	0.80	74165N	1.36
74LS93N	1.10	74C90N	0.85	7448N	0.80	74167N	2.50
74LS95AN	1.10	74C93N	0.85	7450N	0.22	74174N	1.60
74LS96N	1.35	74C95N	1.04	7451N	0.22	74175N	1.00
74LS107N	0.42	74C107N	1.22	7453N	0.22	74176N	0.90
74LS109N	0.42	74C150N	4.14	7454N	0.22	74177N	0.90
74LS122N	0.80	74C151N	2.47	7460N	0.22	74180N	1.00
74LS123N	0.83	74C154N	3.68	7470N	0.46	74181N	2.00
74LS124N	2.70	74C157N	2.21	7472N	0.30	74182N	0.80
74LS125N	0.50	74C160N	1.11	7473N	0.44	74184N	1.50
74LS126N	0.50	74C161N	1.11	7474N	0.32	74185AN	1.50
74LS136N	0.44	74C162N	1.11	7475N	0.80	74188AN	3.25
74LS145N	1.30	74C163N	1.11	7476N	0.45	74189N	2.60
74LS151N	1.07	74C164N	1.04	7480N	0.60	74190N	1.40
74LS153N	0.58	74C165N	1.04	7481N	1.00	74191N	1.20
74LS154N	1.45	74C173N	0.90	7482N	0.90	74192N	1.20
74LS155N	1.20	74C174N	0.90	7483N	1.05	74193N	1.20
74LS156N	1.20	74C175N	0.90	7484N	1.20	74196N	1.20
74LS158N	0.65	74C192N	1.11	7485N	1.36	74197N	1.00
74LS160N	1.43	74C193N	1.11	7486N	0.36	74198N	2.00
74LS161N	0.85	74C195N	1.04	7489N	2.45	74199N	2.00

CMOS

4000	0.22	4016	0.52					4068	0.27	4086	0.89
4001B	0.22	4017B	1.05	4030	0.84	4050B	0.85	4069B	0.24	4089B	2.10
4002	0.22	4018B	1.05	4031B	2.25	4051B	0.85	4070B	0.85	4093B	1.00
4006	1.25	4019B	0.52	4035B	1.30	4052B	0.86	4071B	0.24	4094	2.30
4007	0.22	4020B	1.15	4037	1.20	4053B	0.98	4072	0.27	4095	1.30
4008B	0.99	4021	1.05	4041B	0.85	4054	1.48	4073B	0.24	4096	1.30
4009	0.58	4022B	1.00	4042B	0.86	4055	1.65	4075B	0.24	4097	4.65
4010	0.58	4023B	0.22	4043	1.05	4056	1.65	4076B	0.99	4098	1.00
4011B	0.22	4024B	0.76	4044	1.00	4059	6.00	4077	0.70	4510B	1.20
4012	0.22	4025B	0.22	4045	1.76	4060B	1.15	4078	0.27	4511	1.75
4013B	0.52	4027B	0.55	4046B	1.50	4063	1.35	4081B	0.24	4516	2.10
4014	1.00	4028B	0.92	4047B	0.96	4066B	0.75	4082	0.27	4518B	1.20
4015	1.05	4029B	1.10	4049	0.96	4067	4.85	4085	0.89		

NEW LOW PRICES



SIEMENS LEDS + OPTO

Displays 7 seg		*LEDS*	*Red*	*Gr*	*Yell*
Com anode or cath		Small 3mm	.18	.19	.19
RED		Large 5mm	.20	.20	.20
8mm HT	**£1.50**	Extra bright	.40	.40	.40
10mm HT	**£1.55**	I/red LD271	**£0.55**		
14mm HT	**£1.57**	IR receiver	**£1.45**		
18mm HT	**£1.85**	Opto coupler	**£1.55**		

Full range + data in our '78 catalogue

1978 CATALOGUE

40 PAGE CATALOGUE

New enlarged micro section – largest range of quality components from franchised suppliers available in UK. All VAT inclusive prices. Over 8,000 line items plus lots more. **45p** post paid, **35p** to callers at any of our four branches.

DIL SKTS

Low profile IC skts

8 pin	**15p**	22 pin	**30p**
14 pin	**16p**	24 pin	**35p**
16 pin	**18p**	28 pin	**45p**
18 pin	**27p**	40 pin	**55p**

FULL RANGE OF

Capacitors
Resistors
Plugs/skts
Meters
Clocks

Diodes
Cables
Cases
in our new
catalogue

TRIACS plastic pack 400v T0220

Texas		12 amp	**93p**
4 amp	**72p**	16 amp	**£1.21**
6 amp	**77p**	20 amp	**£1.87**
8 amp	**82p**	25 amp	**£2.20**

THYRISTORS plastic power

4 amps		*8 amps*		*12 amps*	
100v o	38	100v o	47	100v o	63
200v o	44	200v o	54	200v o	70
400v o	54	400v o	68	400v o	90

Branded Texas quality product

VDU
CONVERT TV SET TO VDU

The new CRT control chip from Thomson CSF SFF96364. Convert your TV set into an electronic VDU – 16 lines x 64 characters – requires RAM, character generator and little else for a basic VDU. Available as chip or full display card. Full cursor control, 5 volts TTL compatible, line erase, full card includes UART, Modem, char, gen etc., comp video out from encoded keybd in.

NEW
chip **£17.20**
full card **£151.00**

Send S.A.E. for data.

★ MAIL ORDER ★

Quick service on all orders – please add 40p for P&P to all orders. Tel. orders on credit cards £10 minimum.

Buy it with Access

BARCLAYCARD VISA

3½ DIGIT PANEL METER KIT

Intersil

NEW!

T106 kit
LCD display.
Batt operated.
Contains all components
reqd for construction
plus PCB. Auto vero
extremely versatile
and accurate easy
assembly kit.

£26.99

WE STOCK MORE

Stocking distributors officially appointed

NATIONAL
TEXAS
MULLARD
SIEMENS
SESCOSEM

VERO
ANTEX
ELECTROLUBE
SIFAM
ARROW HART

MAKES COMPONENTS BUYING EASY

TRAIN FOR SUCCESS

in Radio, Television & Electronics

ICS have helped thousands of ambitious people to move up into higher paid more secure jobs in the field of electronics - now it can be your turn. Whether you are a newcomer to the field or already working in the industry, ICS can provide you with the specialised training so essential to success.

Personal Tuition and Guaranteed Success

The expert and personel guidance by fully qualified tutors, backed by the ICS guarantee of tuition until successful, is the key to our outstanding record in the technical training field. You study at the time and pace tbat suits you best and in your own home. In the words of one of our many successful students: "Since starting my course, my salary has trebled and I am expecting a further increase when my course is completed."

City and Guilds Certificates

Excellent job prospects await those who hold one of these recognised certificates. ICS can coach you for:
Telecommunications Technicians
Radio, T.V. Electronics Technicians
Technical Communications
Radio Servicing Theory
Radio Amateurs
Electrical Installation Work
Also MPT Radio Communications Certificate

Diploma Courses

Colour T.V. Servicing
Electronic Engineering & Maintenance
Computer Engineering and Programming
Radio, T.V. and Audio, Engineering & Servicing
Electrical Engineering, Installations & Contracting

Other Career Courses

A wide range of other technical and professional courses are available including GCE.

FREE BOOK

Post this coupon or 'phone today for free ICS careers guide.

Name ____________________

Address ____________________

____

____________________ Age __________

ICS

To ICS, Dept. A273, Intertext House,
London SW8 4UJ
or telephone 01-622 9911 (all hours)

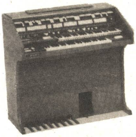
WERSI SELF-BUILD KITS

at BREADBOARD '78
SEYMOUR HALL, LONDON, W.1
21-25 NOVEMBER '78

***SEE** the KITS*

***HEAR** the SOUNDS*

***TALK** to the SPECIALISTS*



AURA SOUNDS
COPTHORNE BANK
CRAWLEY
W. SUSSEX
TEL. 0342 713338

Motorola, **1 WATT AUDIO AMPLIFIER I.C.**

9-16V 8-16Ω, 10-400MV sensitivity, S.C. proof, no heat sink required. Supplied with data and circuits, **90p.** Data and circuits alone, **20p** + SAE.

BARGAIN PACKS

Don't let your environment dehydrate you. Buy a Honeywell **Humidity Controller** membrane operated with ¼" shaft, ideal for greenhouses, centrally heated homes, etc. Build your own humidity alarm, 3·75A. Contacts at 250V **£1.50** each. 3 for **£4.00**

4 aluminium boxes 128 x 44 x 38 mm ideal for signal injectors, etc. **£1.00.**

100 miniature reed switches ideal for burglar alarms, model railways, etc. **£3.30.**

6 × 6-pole 12 volt reed relays on board **£2.45.**

High quality computer panels smothered in top grade components: 5 lbs **£4.75**; 10 lbs **£8.95.**

Miniature edgewise panel mounting **level meters** 200 ua.fsd **90p.**

Miniature transistorised f.m. front end with integral tuning gang 88-108MHz **£2.50.**

New U.H.F. transistor TV tuners

Rotary type with slow drive and AE. socket **£2.50.**

Aluminium TV coax plugs. 10 for **£1.00.**

Hardware Packs each containing 100's of items including: BA nuts and bolts, Nylon, Self-tapping, Posidrive, "P" clips, Cable clamps, Fuse holders, Spire nuts etc, etc. **£1.00** per pound. Heavily insulated E.H.T. Discharging Probe with lead and earth connector **60p** each.

Ultrasonic transducers, transmitter and receiver 14mm diam. 40kcs **£4.25** per pair.

Magnetic earpieces with plug and lead **25p** each. 5 for **£1.00.**

Crystal earpieces with lead **40p** each. 3 for **£1.00.**

10 assorted **convergence pots £1**

12 quil, low profile I.C. sockets, 14 pin **£1**

DE LUXE FIBRE GLASS
PRINTED CIRCUIT ETCHING KITS

Includes 150 sq. ins. copper clad f/g board, 1 lb ferric chloride, 1 dalo etch resist pen, abrasive cleaner, 2 mini drill bits, etch tray and instructions – only **£5.30.**

150 sq. in. fibre glass board	**£2.00**
Dalo pen	**90p**
1 lb ferric chloride to mil spec	**£1.25**
5 lbs ferric chloride to mil spec	**£5.00**
Instruction sheet	**20p**

VERNITRON FM4 10·7mHz miniature ceramic filters **50p** each. 3 for **£1.00.**

Miniature mains transformers, fully shrouded. 240V in 6-0-6V at 100MA. out. Ex. New equipment, complete with mains lead and plug on input and short leads on output. **95p.**

Semiconductor Bargains

TH3 Thermistors 10 for **£1.00.**

100 new and marked transistors. Lots of types including BC148, BC154, BF274, BC212L, BF200 etc. **£4.95.**

200 new and marked transistors, including all above plus 2N3055, AC128, BFY50, BD131etc. **£9.95.**

100 mixed diodes including zener, power and bridge types Marked and Unmarked **£2.95.**

Bridge rectifier 100V 2.5 amp. 4 for **£1.00.**

Brand new ITT 25kV T.V. triplers for Decca Bradford chassis **£2.50.** 5 for **£10.00.**

50 Germanium diodes ideal for crystal sets etc. **£1.00.**

Full spec. I.R. diodes, 200V 1A. 20 for **£1.00.** 100 for **£4.50.** SN76115N **£1.00.**

BF200, 6 for **£1.** BC212L, 10 for **£1.** BC154, 12 for **£1.** BF274, 12 for **£1.** BC148, 12 for **£1.**

Varicap diodes, 10 for **£1.**

Component Bargains

300 mixed resistors ¼ & ½ watt **£1.50.** 300 modern mixed caps, most types, **£3.30.** 200 mixed resistors, mostly 1 & 2 watt, **£1.50.** 100 mixed polyester caps **£2.20.** 100 mixed modern miniature and ceramic plate caps **£1.20.** 100 mixed electrolytics **£2.20.** 300 printed circuit resistors **£1.00.** 25 mixed pots and presets **£1.50.** 100 mixed carbon film and metal film resistors mostly miniature lots of values, **£1.20.** 500 for **£4.90.** 100 mixed high wattage resistors, wirewound, etc. **£2.20.** 20 assorted VDRs and Thermistors **£1.20.** 25 assorted preset pots, skeleton, etc. **£1.20.**

Bargain Parcels Save Pounds

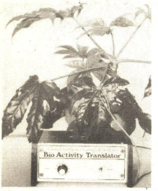
Huge quantities of electronic components must be cleared as space required. 1000's of capacitors, resistors, transistors. Ex equipment panels etc. covered in valuable components. No time to sort. Must sell by weight 7 lbs – **£4.95**; 14 lbs – **£7.95.**

40p P & P ON ALL ABOVE ITEMS. SEND CHEQUE OR POSTAL ORDER WITH ORDER TO **SENTINEL SUPPLY, DEPT PE, 149A BROOKMILL RD., DEPTFORD SE8**

LISTEN TO THE SECRET WORLD OF PLANTS

As featured on Horizon, Nationwide, Radio & Worldwide Press

First time in the U.K. in Kit Form, the revolutionary concept of a Biological Amplifier & Sound Synthesiser in one unit, the *Amazing*



Bio Activity Translator™.

- ★ Experience the unique Musical Form of Plants
- ★ Hear the beautiful patterns of sound – created by their natural response
- ★ Compare house plants' reactions to people – with the distinct tunes of those outside
- ★ Easy to operate, internal speaker & batteries

The naturally generated Bio Electric potential across a plant leaf is picked up by 2 carbon foam electrodes. When amplified and filtered, a VCO, VCA and other exclusive synthesiser circuits are programmed by the control voltage from the plant to produce tracking sequences of notes. These follow in pitch, rhythm and volume the ever changing signal from the plant.
The kit includes 6 I.C's, 3 transistors, all high quality components, tinned and drilled fibre glass P.C.B., loudspeaker and comprehensive assembly instructions. Also included is a free case, ready punched, with wooden end cheeks and stick on silkscreened front panel for a really professional finish.
Runs on 2 × 4½ volt batteries (not supplied).

SPECIAL INTRODUCTORY OFFER INCLUDES FREE CASE
KIT £19.90 ASSEMBLED AND TESTED £27.50 PRICE INCLUDES P & P AND VAT

Allow 14 days for delivery. Send Cheque or Postal Order to:

JEREMY LORD SYNTHESISERS, (Dept PE)
7 London Stile, London W.4.

TRANSISTORS	p
ACY 20	34
ASY 66	90
BC 107	8
BC 108	8
*BC 147/A	8
*BC 148	8
*BC 149/C	8
*BC 158	9
*BC 171A	10
*BC 207B	11
BC 348	11
BC 351	10
BCY 70	14
BCY 71	14
BCY 72	14
BD 115	43
BD 131	33
BD 135	34
BD 139	33
BD 695A	65
BD 696A	65
BF 115	18
BF 185	24
*BF 194	9
*BF 195	9
*BF 197	11
*BF 198	17
BF 200	26
BF 257	26
BF 258/9	24
BF 324	28
*BF 336	28
*BF 337	30
*BFR 80	25
BFY 50	1
BSX 19/20	16
BT 106	130
*BU 205	150
*BU 208	160
*BU 208A	175
MJE 340	43
MJE 520	43
OC 201	70
TIP 31A	38
TIP 42A	62
*ZTX 212/B	16
*ZTX 302	11
*ZTX 502	12
2N 930	16
2N 3053	20
2N 3055	50
*2N 3703	8
*2N 3705	8

DIODES	p
*AA 119	6
*BY 127	10
1N 4001/2	4
1N 4004/5	5
1N4006/7	6
*1S 44	4
*1S 940	4
*1S 941	4

LINEAR I.C.'s	p
741 8P	19
555 8P	25

REGULATORS	p
7812	60
7815	60

TTL	p
7400	13
74L00	24
7401	13
7404	14
74L04	27
7405	14
7408	17
7409	17
7413	30
7420	15
7427	27
7430	15
7440	15
7445	80
7472	25
7473	30
74L73	49
7474	27
74L74	43
7476	30
7480	45
7482	69
7483	72
7490	33
7491	75
74L91	145
7493	32
7495	60
7496	57
74100	95
74107	29
74121	25
74123	48
74151	64
74190	100

W/W RESISTORS	p
2.5W Axial	10
5W Radial	9
10W Axial	9
15W Radial	10

BARGAIN PAKS
ALL ITEMS NEW & MARKED

***PAK 1**
100 Gen. Purpose Transistors including, BC 149, 2N 3703, etc. **£5.00**

PAK 2
20 Transistors including, BF 115, BD 131, etc. **£5.50**

PAK 3
100 Mixed W/W Resistors including 2.5W, 5W, 10W, etc. **£3.50**

PAK 4
100 off 74 series with Preformed Pins including, 7440, 7430, etc. **£4.00**

***PAK 5**
100 Gen. purpose Diodes including, 1S 44, 1S 941, etc. **£2**

Quantity Discounts Available. Min. Order £2.00, P. & P.30p. VAT please add 8% except those marked * which are 12.5%.
S.A.E. for Lists. Export, Wholesale, and Industrial Enquiries Welcome.

K & A DISTRIBUTORS
52, Barkby Road, Syston, Leicester LE7 8AF. Tel: 0533 609391

HAVE YOU DONE IT LATELY!

Fit a new tape head and transform the performance of your tape recorder

MONOLITH
THE MONOLITH ELECTRONICS CO. LTD.

QUALITY
REEL TO REEL
AND CASSETTE TAPE HEADS

Full Catalogue 25p

Please enclose 20p P&P with order

B24–RP stereo cassette glass/ferrite record/playback £9.84
B12–01 mono cass. playbk. £1.60 B24–01 stereo cass. playbk. £2.80
A28–05 stereo 8tk cartridge £1.80 E12–09 stereo/mono cass. erase £1.80

5/7 Church St, Crewkerne, Som. Tel. (0460) 74321

GREENWELD

443 Millbrook Road Southampton
SO1 OHX Tel:(0703) 772501

All prices quoted include VAT. Add 25p UK/BFPO Postage. Most orders despatched on day of receipt. SAE with enquiries please. MINIMUM ORDER VALUE £1. Official orders accepted from schools, etc. (Minimum invoice charge £5). Export/Wholesale enquiries welcome. Wholesale list now available for bona-fide traders. Surplus components always wanted.

EXPERIMENTERS CALCULATOR

Based on the C500 chip, this pack of parts enables the more experienced constructor to make an 8 digit 4 function calculator. The comprehensive data supplied includes full size layout of PCB required, types of suitable display and keyboard that can be used etc. Components included in the pack are C500 calculator chip, driver IC, all components for inverter/clock circuits, R's C's etc. All for only **£3·50.**

RELAYS

W847 Low profile PC mntg 10×33×20mm 6V coil, SPCO 3A contacts. **93p**
W832 Sub. min type, 10×19×10mm 12V coil DPCO 2A contacts **£1·15**
W701 6V SPCO 1A contacts 20×30×25mm Only **56p**
W817 11 pin plug in relay, rated 24V ac, but works well on 6V DC. Contacts 3 pole c/o rated 10A. **95p**
W819 12V 125OR DPCO 1A contacts. Size 29×22×18mm. min plug-in type **72p**
W839 50V ac (24V DC) coil. 11 pin plug in type. 3 pole c/o 10A contacts Only **85p**
W846 Open construction mains relay. 3 sets 10A c/o contacts. **£1·20**
Send SAE for our relay list – 84 types listed and illustrated.

AMPLIFIER KIT £1·75

Mono gen. purpose amp with tone and Vol/on-off controls. Utilizes sim. circuitry to above amp. Output 2W into 8 ohms. Input matched for crystal cartridge. 4 transistor circuit. Simple to build on PCB provided. Can be either battery or mains operated. (For mains powered version add **£2·20** for suitable transformer.) Blue vinyl covered aluminium case to suit (W372) **£1·30**

STEREO AMPLIFIER CHASSIS £5·50

Complete and ready built. Controls: bass, treble, volume/on-off, balance. 8 transistor circuit gives 2 watts per channel output. Just needs transformer and speakers for low cost stereo amp. Suitable metal cabinet (W374) **£2·00** – or buy the amp, case and transformer for **£10·00** and get DIN speaker sockets and knobs free!!

TMS4030 RAM

4096 bit dynamic RAM with 300ns access time; 470ns cycle time; single low capacitance high level clock i/p; Fully TTL compatible; Low power dissipation. Supplied with data **£2·75**

MISCELLANEOUS IC's

Supplied with data if requested. MC3302 quad comp. **120p**; 710 diff comp. (TO99) **40p**; ZN1034E precision timer **£2·25**; LM711 Dual diff comp **65p**; LM1303 dual stereo pre-amp **75p**; MC1469R voltage reg **£1·50**; UPC1025H audio **£3·50**; 575C2 audio **£2·88**; TDA2640 audio **£2·92**; SN75110 dual line driver **70p**; MC8500 CRCC gen POA

EDGE CONNECTORS

Special purchase of these 0·1" pitch double-sided gold-plated connectors enables us to offer them at less than one-third of their original list price!
18 way **41p**; 32 way **72p**; 40 way **90p.**

HEAT SINK OFFER

Copper TO5 sink 17mm dia × 20mm. 10 for **40p**; 100 for **£3**; 1000 for **£25**

74 SERIES PACK

Selection of boards containing many different 74 series IC's. 20 for **£1;** 50 for **£2.20;** 100 for **£4.**

THE NEW 1978-9 GREENWELD *CATALOGUE*

FEATURES INCLUDE:

- 50p Discount Vouchers
- Quantity prices for bulk buyers
- Bargain List Supplement
- Reply Paid Envelope
- Priority Order Form
- VAT inclusive prices

PRICE **30p** + 15p POST

AIR FRESHENER KIT

As featured in Nov EE. Complete kit inc. case and instructions. Only **£7.95** + 55p p & p.

BC182B OFFER

Special Offer for quantity users 1k .035 VAT; 5k .032 VAT. Price negotiable on 10k. Approx 70k available.

DIODE SCOOP!!!

We have been fortunate to obtain a large quantity of untested, mostly unmarked glass silicon diodes. Testing a sample batch revealed about 70% useable devices – signal diodes, high voltage rects and zeners may all be included. These are being offered at the incredibly low price of **£1·25**/1000 – or a bag of 2500 for **£2·25.** Bag of 10,000 **£8.** Box of 25,000 **£17·50.** Box of 100,000 **£60.**

POLYTHENE SHEET

Size 36 x 18" 200g. Hundreds of uses around the home. 100 sheets for **£1.50.** Box of 1500 for **£19.**

PC ETCHING KIT MK III

Now contains 200 sq. ins. copper clad board, 1lb. Ferric Chloride, DALO etch-resist pen, abrasive cleaner, two miniature drill bits, etching dish and instructions. **£4·25**

BUY A COMPLETE RANGE OF COMPONENTS AND THESE PACKS WILL HELP YOU

- ★ ***SAVE ON TIME—No delays in waiting for parts to come or shops to open!***
- ★ ***SAVE ON MONEY—Bulk buying means lowest prices—just compare with others!***
- ★ ***HAVE THE RIGHT PART—No guesswork or substitution necessary!***

ALL PACKS CONTAIN FULL SPEC, BRAND NEW, MARKED DEVICES— SENT BY RETURN OF POST. VAT INCLUSIVE PRICES.

K001 50V ceramic plate capacitors, 5%. 10 of each value 22pF to 1000pF. Total 210, **£3·35**
K002 Extended range, 22pF to 0·1μF. 330 values **£4·90**
K003 Polyester capacitors, 10 each of these values: 0·01, 0·015, 0·022, 0·033, 0·047, 0·068, 0·1, 0·15, 0·22, 0·33, 0·47μF. 110 altogether for **£4·75**
K004 Mylar capacitors, min 100V type. 10 each all values from 1000pF to 10,000pF. Total 130 for **£3·75**
K005 Polystyrene capacitors, 10 each value from 10pF to 10,000pF, E12 series 5% 160V. Total 370 for **£12·30**
K006 Tantalum bead capacitors. 10 each of the following: 0·1, 0·15, 0·22, 0·33, 0·47, 0·68, 1, 2·2, 3·3, 4·7, 6·8, all 35V; 10/25 15/16 22/16 33/10 47/6 100/3. Total 170 tants for **£14·20**
K007 Electrolytic capacitors 25V working, small physical size. 10 each of these popular values: 1, 2·2, 4·7, 10, 22, 47, 100μF. Total 70 for **£3·50**
K008 Extended range, as above, also including 220, 470 and 1000μF. Total 100 for **£5·90**
K021 Miniature carbon film 5% resistors, CR25 or similar. 10 of each value from 10R to 1M, E12 series. Total 610 resistors, **£6·00**
K022 Extended range, total 850 resistors from 1R to 10M **£8·30**
K041 Zener diodes, 400mW 5% BZY88, etc. 10 of each value from 2·7V to 36V, E24 series. Total 280 for **£15·30.**
K042 As above but 5 of each value **£8·70**

TRANSFORMERS

All mains primary: 12-0-12V 50mA **85p;** 100mA **95p;** 1A **£2.50.** 6-0-6V 100mA **85p;** 1½A **£2.40.** 9-0-9V 75mA **85p;** 1A **£2.10.** Multitapped type 0-12-15-20-24-30V, 1A **£3.95;** 2A **£5.35;** 3A **£6.90.** 20V 2¾A **£3.90;** 25V 1¾A **£2.25;** 12V 8A **£4;** 24V 5A **£7.50;** 0-22-34-41V 4A **£7.50;** 20V @ 300mA twice **£2.50;** 12V @ 250mA twice **£2.00.**

ALL PRICES INCLUDE VAT & P/P **CATALOGUE 40p**
MIN ORDER £2.00

THE COMPONENT CENTRE

7 LANGLEY ROAD - WATFORD - HERTS - WD1 3PS
Phone Watford 45335 *Callers welcome* **9.30-5.30 Mon-Sat. EC. Wed.**

TRANSISTORS

AC126	21p	BC547	14p	MJ2955	99p
AC127	21p	BC548	14p	MJE340	64p
AC128	21p	BC549	14p	MJE2955	99p
AC176	21p	BC557	14p	MJE3055	68p
AC187	23p	BCY34	74p	OC28	108p
AC188	23p	BCY70	17p	OC35	108p
AD149	65p	BCY71	20p	OC71	19p
AD161	50p	BCY72	17p	OC84	46p
AD162	50p	BD115	59p	TIP29	50p
AF114	30p	BD124	97p	TIP30	52p
AF115	27p	BD131	47p	TIP31	59p
AF116	25p	BD132	47p	TIP32	59p
AF117	23p	BD135	43p	TIP33	107p
AF118	30p	BD136	50p	TIP34	60p
AF124	32p	BD137	50p	TIP35	253p
AF125	32p	BD138	51p	TIP36	389p
AF126	32p	BD139	51p	TIP41	59p
AF139	40p	BD140	52p	TIP42	59p
AF239	45p	BF173	30p	TIP2955	126p
BC107	9p	BF179	37p	TIP3055	64p
BC108	9p	BF180	37p	ZTX108	12p
BC109	9p	BF181	37p	ZTX300	12p
BC147	10p	BF182	37p	ZTX500	12p
BC148	10p	BF183	37p	2N1305	25p
BC149	10p	BF194	13p	2N1306	39p
BC157	11p	BF195	13p	2N1711	21p
BC158	11p	BF196	13p	2N2219	21p
BC159	11p	BF197	16p	2N2904	26p
BC168	12p	BF200	36p	2N2905	26p
BC169	12p	BF224	16p	2N2906	20p
BC171	12p	BF257	37p	2N2926G	9p
BC172	12p	BF258	40p	2N2926R	9p
BC173	12p	BF259	44p	2N2955	99p
BC177	16p	BFR39	30p	2N3053	17p
BC178	16p	BFX29	34p	2N3054	54p
BC179	16p	BFX30	38p	2N3055	54p
BC182L	13p	BFX84	27p	2N3702	10p
BC183L	11p	BFX85	29p	2N703	10p
BC184L	13p	BFX86	31p	2N3704	12p
BC212L	13p	BFX87	31p	2N3705	12p
BC213L	13p	BFX88	29p	2N3706	12p
BC214L	14p	BFY50	17p	2N3708	12p
BC238	14p	BFY51	17p	2N3709	11p
BC303	30p	BSX20	21p	2N3711	10p
BC328	15p	BU105	191p	TIS43	40p
BC338	15p	BU208	299p	2N2646	56p

S.C.R. THYRISTORS

1A/50V	28p	5A/400V	59p	10A/400V	70p
1A/200V	38p	5A/600V	75p	10A/600V	83p
1A/400V	40p	5A/800V	82p	10A/800V	129p
1A/600V	58p	7A/100V	59p	16A/100V	63p
3A/100V	36p	7A/200V	68p	16A/200V	67p
3A/200V	38p	7A/400V	120p	16A/400V	82p
3A/400V	51p	7A/600V	123p	16A/600V	115p

DIODES

BY127	16p
OA47	9p
OA70	9p
OA79	14p
OA81	15p
OA85	14p
OA91	7p
OA95	9p
OA200	9p
OA202	9p
IN914	4p
IN916	6p
IN4001	6p
IN4002	6p
IN4003	6p
IN4004	7p
IN4005	10p
IN4006	10p
IN4007	11p
3A-50V	16p
3A-100V	16p
3A-200V	18p
3A-400V	20p
3A-600V	25p
10A-50V	25p
10A-100V	25p
10A-200V	28p
10A-400V	36p
10A-600V	42p

BRIDGE RECS

1A 50V	22p
1A 100V	24p
1A 200V	27p
1A 400V	30p
1A 600V	34p
2A 50V	34p
2A 100V	36p
2A 200V	38p
2A 400V	40p
2A 600V	42p

TRIACS

2A 100V	26p
2A 200V	42p
2A 400V	71p
6A 100V	50p
6A 200V	66p
6A 400V	81p
10A 100V	68p
10A 200V	100p
10A 400V	113p
10A 400V Plas.	130p

LINEAR I.C's

CA3011	86p
CA3014	190p
CA3018	86p
CA3020	174p
CA3023	186p
CA3028	85p
CA3030	120p
CA3035	190p
CA3036	115p
CA3042	198p
CA3045	275p
CA3046	90p
CA3048	205p
CA3049	154p
CA3052	152p
CA3054	73p
CA3078	136p
CA3080	57p
CA3081	148p
CA3086	47p
CA3090	329p
CA3130E	113p
CA3140E	74p
CA3160E	140p
LM301	39p
LM308	54p
LM380	106p
LM381	120p
LM710	41p
LM741	24p
LM747	73p
LM748	36p
LM3900	73p
MC1304	292p
MC1310	197p
MC1458	78p
MC1496	78p
NE555	33p
NE556	76p
NE561	385p
NE562	385p
NE565	138p
NE566	126p
NE567	175p
SN76003	185p
SN76013	185p
SN76023	160p
SN76033	259p
TAA621	257p
TAA661	175p
TBA540	236p
TBA641	281p
TBA800	102p
TBA810	113p
TBA820	90p

C.-MOS / T.T.L.

C.-MOS		T.T.L.	
4000	16p	7400	13p
4001	18p	7401	15p
4002	18p	7402	16p
4006	110p	7403	17p
4007	20p	7404	22p
4008	97p	7405	22p
4009	62p	7406	44p
4010	62p	7407	44p
4011	19p	7408	22p
4012	20p	7409	23p
4013	59p	7410	16p
4014	108p	7411	24p
4015	97p	7412	24p
4016	59p	7413	38p
4017	99p	7414	66p
4018	99p	7416	33p
4019	65p	7417	33p
4020	119p	7420	18p
4021	99p	7425	28p
4022	94p	7427	28p
4023	21p	7430	20p
4024	83p	7432	28p
4025	20p	7437	29p
4026	190p	7441	74p
4027	59p	7442	74p
4028	96p	7445	123p
4029	118p	7446	123p
4030	62p	7447	102p
4031	249p	7448	130p
4032	108p	7454	19p
4033	157p	7470	39p
4035	130p	7472	28p
4041	87p	7473	39p
4042	85p	7474	33p
4043	99p	7475	48p
4044	96p	7476	40p
4045	150p	7480	46p
4046	131p	7482	91p
4047	95p	7483	90p
4049	65p	7485	106p
4050	65p	7486	36p
4054	120p	7489	399p
4055	140p	7490	57p
4056	140p	7491	82p
4060	117p	7492	57p
4066	70p	7493	57p
4067	410p	7494	83p
4068	24p	7495	70p
4069	22p	7496	83p
4070	60p	74100	130p
4071	22p	74107	36p
4072	23p	74118	125p
4076	167p	74121	38p
4077	65p	74122	55p
4078	24p	74123	103p
4081	23p	74144	345p
4082	23p	74145	83p
4086	24p	74153	62p
4501	19p	74154	138p
4502	130p	74165	115p
4507	59p	74174	132p
4510	132p	74175	79p
4516	132p	74180	85p
4518	114p	74181	295p
4519	60p	74192	131p
4532	138p	74193	131p
4539	119p	74198	185p

D.I.L. SOCKETS

8 pin	10p	16 pin	14p
14 pin	13p	28 pin	30p

OPTO

TIL209	Red	14p
TIL209	Yellow	24p
TIL209	Green	24p
·2	Red	18p
·2	Yellow	30p
·2	Green	30p
TIL209 Clip		4p
·2 Clip		5p

NEONS

Red	39p
Green	39p
Amber	39p
Neon Bulb	20p

RESISTORS

0·3 watt 10Ω to 1MΩ E24	2p
0·5 watt 10Ω to 10MΩ E24	2½p
2·5 watt 0·22Ω to 10Ω w/w	23p
5 watt 4·7Ω to 10KΩ w/w	12p
10 watt 10Ω to 10KΩ w/w	15p

POTENTIOMETERS

1KΩ-2MΩ S/gang Lin-Log	27p
5KΩ-2MΩ S/gang Switch Log	55p
5KΩ-2MΩ D/gang Lin-Log	70p

SLIDERS

5KΩ-500KΩ S/G Lin-Log	73p
5KΩ-500KΩ D/G Lin-Log	88p
Presets sub. min. 100Ω-5MΩ	10p
Slider Bezzels	21p
Slider knobs	10p

CAPACITORS

Min ceramic
22 pf to 3300 pf **4p** each

SWITCHES

Large	SPST	27p
Toggle	SPDT	29p
	DPDT	35p
STD	SPST	66p
Toggle	SPDT	70p
	DPDT	75p
Min	SPST	54p
Toggle	SPDT	58p
	DPDT	70p
C. off	DPDT	90p
Sub. min.	SPST	48p
Toggle	SPDT	52p
	DPDT	60p
Push button	SPST	60p
	SPDT	69p
	DPDT	91p
Bias push make		15p
Bias push brake		20p
Slide sub.min.	DPDT	13p
Slide std.	DPDT	13p
Slide C. off	DPDT	15p

ROTARY (Adjustable stop)

1P/2-12 way 2P/2-6 way
3P/2-4 way 4P/2-3 way
Price each **46p**

LOUDSPEAKERS

1½in	8Ω	72p
1¾in	8Ω	72p
2in	8Ω	72p
2¼in	8Ω	64p
2½in	8Ω	64p
2½in	64Ω	72p
2¾in	8Ω	76p
2¾in	80Ω	118p

TRANSFORMERS

Mains prim 220-240V

6-0-6	100M/A	93p
9-0-9	75M/A	97p
12-0-12	100M/A	99p
0-6-0-6	280M/A	150p
0-12-0-12	150M/A	150p
6-0-6	1·5A	345p
9-0-9	1A	280p
9-0-9	2A	398p
12-0-12	1A	317p
15-0-15	1A	350p
20-0-20	2A	544p
25-0-25	2A	585p
30-0-30	2A	625p
12V	2A	367p

Antex X2 5 watt Iron	385p
Antex C2 15 watt Iron	385p
Antex CX 15 watt Iron	385p
Antex stand	155p
Desoldering gun	640p
Spare nozzle	90p
PP3 Batt clips	6p
PP9 Batt clips	10p
Ferric chloride	95p
Etching pen	81p
Etching kit	245p
Telephone pickup coil	70p
Ear piece std.	16p
Ear piece crystal	33p
Speaker cloth, black 36in x 25in	120p

COMP. KIT

BRANDED NEW DEVICES

A pack of useful general purpose components.

Resistors 10 off each
Value E12 10Ω-8·2MΩ
Capacitors 100 mixed from 100 pf to 1000µF
5×NPN 5×PNP Gen. purp.
10×IN914 4×4002
2×741 1×555
3×sockets L.E.D's
Switches Batt. clips
Audio TRX Tuning cap
Relays Etc.

EXCELLENT VALUE

ONLY **£10·95**

W.K.F. ELECTRONICS

(R.P.C.B.S. Ltd.)

THE CIRCUIT BOARD SPECIALISTS – UNIVERSAL SUPPLIERS

Contractors for: P.C.B. Production, Contract Drilling, Electroplating, Laminate Cutting.

Services for: Master Artwork Preparation, Process Photography, Circuit Diagrams, Layouts & Legends.

Consultants for: Instrument Engineering, Automatic Control & Applications.

Do-It-Yourself Won't Do: Today's assemblies demand close tolerances.

Goodbye to the Long Wait: 3 to 7 Day Prototype P.C.B. Production Service.

Quotations: By Return. **Guaranteed Quality** on every process.

Short or Long Term Production now acceptable from **1 to 10,000 units.**

We Universally Distribute: Laminate, Carbide, Drill Bits & Routers, Process Chemicals (any), Presensitised Laminate, Drilling Machines (Manual, Multi-spindle, N.C./C.N.C. Control), Graphic Art Draughting materials & aids.

We Manufacture to Specification: Quality Circuit Boards (Single or Double Sided with any finish). Due to expansion we now have space available for prototype or long term production.

For quotations: Submit Copy Masters, Roughs, Circuit or Sample units for costing.

To:
W.K.F. ELECTRONICS
FLEET HOUSE, WELBECK STREET
WHITWELL, WORKSOP, NOTTS.
TEL: WORKSOP (0909) 720695
TELEX: 547616
Telephone Quotations: Ask for pricing

NOTICE TO OTHER MANUFACTURERS

IS YOUR DRILLING/ROUTING DEPARTMENT A BOTTLENECK?
IF SO TRY OUR SERVICE FOR DRILLING AND ROUTING.

THE RATES ARE VERY REASONABLE AND THE FAST SERVICE WILL ENSURE THAT YOUR CUSTOMERS' DELIVERIES ARE MET.

SOUND AND TIME . . .

With the superb AMELTONE Electronic Digital LED Alarm Clock Radio. Mains operated with 3 wave band radio receiving VHF, Long Wave and Medium Wave. The alarm can be set to radio or buzzer. Special features include 'Snooze' button and multi-function controls for adjusting Time of Day, Time of Alarm and Sleep Countdown Time. The bright green display has an adjustable dimmer control, together with a switched seconds display. This sleek white unit features ultra-clear radio reception and costs only **£19.95** including VAT, plus £1 Post and Packing. Save £££'s off the Normal Shop Price!

SPECIAL MAIL ORDER OFFER

£19.95 inc. VAT plus £1 Post and Packing.
(Access orders accepted by telephone)

ALSO AVAILABLE:

LCD ALARM CLOCK featuring – Alarm; Snooze; Back Light; 1 Year Battery Life; Travel Pouch. (Dimensions: 4″ x 2″).

Offer **£17.50** inc. VAT and Postage.

DROP US A LINE for full details of the following:

The NEW Computer Chess Challenger with TEN levels of Play **£199.95.** SAE.
Sinclair Pocket Television **£199.95.** SAE.
The New ELMAC 4″ Oscilloscope **£109** inc. VAT and delivery. SAE.
INTEL MCS 80(SDK) Computer Kit **£190** inc. VAT. SAE.
Heavy duty PROM ERASER **£56** plus VAT. SAE.
Full range of CPU's and support chips. SAE.
e.g. Intel 8080A **£8** inc. VAT.
Commodore PET Computer-8K bytes RAM 2001-8 **£695** inc. VAT and UK delivery. SAE.
Fairchild Programmable Cartridge T.V. Game Computer. **£119.95** inc. VAT. SAE.
Atari Video Computer Game System. **£169.95** inc. VAT. SAE.
Electronic Dice Thrower **£9.95** inc. VAT.

Send cheque with order to:
GEMINI ELECTRONICS
NEWTON BUILDINGS
NEWTON STREET
MANCHESTER 1
Tel: 061-236 3083

Export enquiries welcome. (Please enclose Int. Reply Coupon)

Mail order and callers by appointment only.

FOR YOUR GUIDANCE

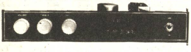
VALUE ADDED TAX

Unless otherwise shown, all prices in advertisements are inclusive of VAT. Where prices are exclusive, readers should ensure that they have added the correct amount of VAT before ordering.

Export orders are not subject to the addition of Value Added Tax.

J.K. RETURN OF POST MAIL ORDER SERVICE *also* WORLDWIDE EXPORT SERVICE

R.C.S. 10 WATT AMPLIFIER KIT



This kit is suitable for record players, tape play back, guitars, electronic instruments or small P.A. systems. Two versions are available. The mono kit uses 13 semiconductors. The stereo kit uses 22 semiconductors. Both kits have printed front panel and volume, bass and treble controls. Spec. 10W output into 8 ohms, 7W into 15 ohms. Response 20c/s to 30kc/s. input 100M.V. high imp. Size 9½ x 3 x 2in. A/C mains operated.

Mono kit **£12·50** Stereo kit **£20** post 45p

Easy to build. Full instructions supplied.

ELAC SPEAKER
10 inch £4.95

Large ceramic magnet 50-16,000 c/s. Bass resonance 55 c/s. 10W. 8 ohm impedance.

CS STEREO PRE-AMP KIT. All parts to build this pre-amp. puts for high, medium or low imp. per channel, with volume ontrol and P.C. Board. Can be ganged to make multi-way mixers.

£2.95 Post 35p

MAINS TRANSFORMERS

AI L POST 75p each

250–0–250V 70mA, 6·3, 2A	£3·45
250–0–250 80mA, 6·3V 3·5A, 6·3V 1A or 5V 2A	£4·60
350–0–350 80mA, 6·3V 3·5A, 6·3V 1A or 5V 2A	£5·80
300–0–300 120mA 2 × 6·3V 2A C.T., 6·3V 2A	£8·50
220V 45mA, 6·3V 2A	£1·75
HEATER TRANS, 6·3V 3A, **£1·45.** ½ amp.	£1·00
GENERAL PURPOSE LOW VOLTAGE. Tapped outputs at	
2A 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30V	£5·30
1A, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£5·30
2A, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£8·50
3A, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£11·00
5A, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£14·50

5, 8, 10, 16V ½A **£2.** 12V 100mA **£1.** 12V 300mA **£1.**

2V 750mA **£1·30.** 40V 2A tapped 10V or 30V **£2·95.** 0-0-10V. 2A **£2·50.** 40V 2A **£2·95.** 30V 5A 34V 2A ct. **£3·75.** × 18V 6A **£9.** 12-0-12V 2 amp **£2·95.** 0-0-20V 1A **£2·95.** 30V 1½A **£2·75.** 20V 1A **£2·20.** V 3 amp **£2·75.** 60V, 40V, 20V or 20-0-20V, 1A **£3·50.** 0-0-30 2A **£7.** 9V 250mA **£1·30.** 30V 2 amp **£3.** UTO TRANSFORMERS. 115V to 230V or 230V to 115V 50W **£5**; 250W **£6**; 400W **£7**; 500W **£8.** HARGER TRANSFORMERS. Input 200/250V for 6 or 12V ½A **£2·75;** 3A **£4;** 4A **£5·20.** ULL WAVE BRIDGE CHARGER RECTIFIERS. 6 or 12V outputs ½A **55p;** 4A **£1·25.** HALF WAVE 12V 1½A **25p.**

ODMAN'S COMPACT 12in ASS WOOFER

ndard 12in diameter fixing with cut sides 12 x n 14,000 gauss magnet 20 watt r.m.s. 4 ohm pedance. Bass resonance 30 c.p.s. Frequency ponse 30-8,000 c.p.s. **£9.95** each. Post £1.00.

10 WATT PER CHANNEL STEREO AMPLIFIER
Ready made in chassis form. Mains operated. Volume balance, treble and bass slider controls. Pick up and tape inputs. Recording output. / Socket. Front panel size: 16½ x 1½in. Chassis size: 13 x 15in. Bargain **£18·50** Post 50p
Made by Rank.

HEATING ELEMENTS WAFER | THIN

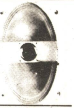
Size 10⅞ × 8¼ × $\frac{1}{16}$in. Operating voltage 200/250V a.c. 250W approx. Suitable for Heating Pads, Food Warmers, Convector Heaters, etc. Must be clamped between two sheets of metal or asbestos.

ONLY **40p** EACH (FOUR FOR **£1·50**)

ALL POST PAID—Discounts for quantity.

.M.I. 13½ × 8in PEAKER SALE!

ith tweeter. And crossover.



0W Model tate 4 or 8 ohm.	**£7·95** Post 45p
5W model ohms.	**£10·50** Post 65p
0W model tate 8 or 15 ohms..	**£11·50** Post 75p

EAK VENEER HI-FI SPEAKER CABINETS

IODEL "A" 20 × 13 × 12in. or 12in. dia. or 10in. speaker. lustrated **£14.50** Post £1.60

IODEL "B" BOOKSHELF or 13 × 8in. EMI oudspeakers. **£8.50** Post £1

.C.S. BOOKSHELF complete with peakers. Size 14 x 9 x 6in. approx. esponse 50 to 14,000 cps 2 watt rms 8 ohms **£19 pair** Post £1.50

COUSTIC WADDING 18in. wide, **20p** ft.

MONO PRE-AMPLIFIER

A mains operated solid state pre-amplifier unit designed to compliment amplifiers without low level phono and tape input stages. This free standing cabinet incorporates circuitry for automatic R.I.A.A. equalisation on magnetic phono input and N.A.B. equalisation for tape heads. Power ON/OFF, PHONO/TAPE switches and pilot lamp are on the front panel; phono socket input and output are rear located. AC mains 240V.

Size 6 × 3½ × 2in. Post 50p

£4·50 ea. – 2 for £8.

BAKER MAJOR 12 INCH £16.88

Post £1·00

30–14,500 c/s. 12in double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c/s. Rated 25W.
NOTE: 4 or 8 or 16 ohms available.

Module kit, 30–17,000 c/s with tweeter, crossover, baffle, 19 × 12½in, instructions. As illustrated. **£20.52**

Please state 4 or 8 or 16 ohms. Post £1·60

"BIG SOUND" BAKER SPEAKERS

Robustly constructed to stand up to long periods of electronic power. As used by leading groups and discos. Useful response 30–13,000 c/s. Bass Resonance 55 c/s.

GROUP "25"

12in 30W
4, 8 or 16 ohms. **£12.96** Post £1

GROUP "35"

12in 40W
4, 8 or 16 ohms. **£15.12** Post £1

GROUP 50/12in

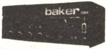
12in 60W
4 or 8 or 16 ohms with aluminium presence dome. **£22.68** Post £1·60

GROUP 50/15in

15in 75W
8 or 16 ohms. **£34.00**
With aluminium presence dome. Post £1·60

Disco, Group + PA Cabinets in stock. Send for Leaflet. Cabinet Fittings, Handles, Corners, Feet, Covering Material all in stock.

BAKER 150 WATT ALL PURPOSE TRANSISTOR AMPLIFIER



Ideal for Groups, Disco, P.A. and Musical Instruments. 4 inputs speech and music 4 way mixing.
Output 4/8/16 ohm. a.c. Mains 240V.
Separate treble and bass controls.
100 volt line model £10 extra. **£85** Carr. £1·50

NEW "DISCO 100 WATT" £59

ALL TRANSISTOR AMPLIFIER CHASSIS Carr £1.

2 inputs. 4 outputs separate volume treble and bass controls. Ideal disco or slave amplifier chassis. Made by Jennings

R.C.S. SOUND TO LIGHT DISPLAY MK II

Complete kit of parts with R.C.S. printed circuit. Three 1000W channels. Will operate from 200mV signal source. CABINET extra £4. KIT =**£17.00**

GOODMANS CONE TWEETER

18,000 c/s 25W 8 ohm. Price **£3·25**

3 WAY CROSSOVER WITH TREBLE & MID RANGE CONTROLS. 50 WATT. **£5** POST £1.

R.C.S. 100 WATT VALVE AMPLIFIER CHASSIS

Professional model. Four inputs. Treble, Bass, Master Volume Controls. Ideal disco, P.A. or groups. S.A.E. for details. 5 speaker outputs. 3 or 8 or 15 ohm. 100V line to order. Suitable carrying case **£16·50.** **£99** plus £2·50 carr.

LOW VOLTAGE ELECTROLYTICS
1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V **10p.** 500mF 12V **15p;** 25V **20p;** 50V **30p.** 1000mF 12V **17p;** 25V **35p;** 50V **47p;** 100V **70p.** 2000mF 6V **25p;** 25V **42p.** 2500mF 50V **62p;** 3000mF 25V **47p;** 50V **65p.** 3900mF 100V **£1·60.** 4700mF 63V **£1·20.** 5000mF 6V **25p;** 12V **42p;** 25V **75p;** 35V **85p;** 5600mF 76V **£1.60;** 1200/76V **80p.**

HIGH VOLTAGE ELECTROLYTICS

8/350V	**22p**	8+8/450V	**50p**	50+50/300V	**50p**
16/350V	**30p**	8+16/450V	**50p**	32+32/450V	**75p**
32/500V	**75p**	16+16/450V	**50p**	100+100/275V	**65p**
50/350V	**50p**	32+32/350V	**50p**	150+200/275V	**70p**

ROBUST BLACK PLASTIC BOX
Size 6¼ x 3¾ x 2in with brushed aluminium facia. Ideal for constructional projects. **£1·50** Post 30p

R.C.S. LOW VOLTAGE STABILISED POWER PACK KITS
All parts and instructions with Zener diode, printed circuit rectifiers and double wound mains transformer. Input 200/240V a.c. Output voltages available 6 or 7·5 or 9 or 12V d.c. up to 100mA or less. Size 3 × 2½ × 1½in. Please state voltage required. **£2·95** Post 45p

ELECTRO MAGNETIC PENDULUM MECHANISM **95p** Post 30p
1·5V d.c. operation over 300 hours continuous on SP2 battery, fully adjustable swing and speed. Ideal displays, teaching electro magnetism or for metronome, strobe, etc.

BSR AUTOCHANGER

Plays 12in, 10in or 7in records Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. a.c. 200/250V. Size 13½ × 11½in. Above motor board 3¼in. Below motor board 2½in.

With STEREO/MONO CARTRIDGE **£12·95** All Post 75p

BSR P182 SINGLE PLAYER. Snake Arm Flared Turntable Ceramic Cartridge	**£19·95**
GARRARD AUTOCHANGER plays all records	**£14·95**
BSR P163 BELT DRIVE DECK, less cartridge	**£27·50**
GARRARD AP76 Single Player less cartridge	**£27·50**

BSR DE LUXE AUTOCHANGER

Features balanced arm. Cueing device, stylus pressure gauge, 3 speed – plays all size records. Fitted with stereo ceramic cartridge. Size: 13 × 12ins. Post £1. **£17.50**
Or with Sonotone V100 magnetic cartridge **£21.50**

R.C.S. DISCO DECK SINGLE RECORD PLAYER

Fitted with auto stop, stereo compatible cartridge. Baseplate. Size 11 × 8½in. Turntable. Size 7in diameter. a.c. mains. 220/250V. 3 speeds plays all size records
Two for £15. Post 75p. **£7.95** Post 45p

HEAVY METAL PLINTHS

With P.V.C. Cover. Cut out for most B.S.R. or Garrard decks. Silver grey finish.
Model "A". Size 12½ × 14½ × 7½in. **£6·50** Post £1·50
Model "B". Size 16 × 13¾ × 7in. **£7·50.**

Extra Large Plinth and Cover. For transcription decks. Size 20 × 17½ × 9in. uncut board. Shop callers only **£18·50.**

TINTED PLASTIC COVERS ONLY
Sizes: 14½ x 12½ x 4½in. **£3.** 17½ x 14 x 4in. **£4.50.** 16¼ x 14 x 4in. **£4.** 15¼ x 13½ x 4in. **£3.75.** 15 × 13½ × 3in, **£3.50.** 17¼ × 9½ × 3½in, **£3.** 14½ x 14¾ x 2½in Rosewood sides **£4.** Ideal for record decks, tape decks, etc. Post **£1.**

BAKER HI-FI SPEAKERS

HIGH QUALITY—BRITISH MADE

SUPERB £24.75
12in 25 watt

Post £1·60

Quality loudspeaker, low cone resonance ensures clear reproduction of the deepest bass. Special copper drive and concentric tweeter cone. Full range reproduction with remarkable efficiency in the upper register.

Bass Resonance	25 c/s
Flux Density	16,500 gauss
Useful response	20–17,000 c/s

8 or 16 ohms models.

AUDITORIUM £22.68
12in 35 watt

Post £1·60

A full range reproducer for high power. Electric Guitars, public address, multi-speaker systems, electric organs. Ideal for Hi-Fi and Discotheques.

Bass Resonance	35 c/s
Flux Density	15,000 gauss
Useful response	25–16,000 c/s

8 or 16 ohms models.

AUDITORIUM £34.00
15in 45 watt

Post £1·60

BLANK ALUMINIUM CHASSIS, 18 s.w.g. 2½in. sides, 6 × 4in. **95p;** 8 × 6in. **£1.40;** 10 × 7in. **£1.55;** 14 × 9in. **£1.90;** 16 × 6in. **£1.85;** 12 × 3in. **£1.20;** 16 × 10in. **£2.20;** 12 × 8in. **£1.70.**
ALUMINIUM PANELS, 18 s.w.g. 6 × 4in. **24p;** 8 × 6in. **38p;** 10 × 7in. **54p;** 12 × 5in. **50p;** 12 × 8in. **70p;** 16 × 6in. **70p;** 14 × 9in. **94p;** 12 × 12in. **£1;** 16 × 10in. **£1.16.**
ALUMINIUM ANGLE BRACKET, 6 × ¾ × ¾in. **15p.**
ALUMINIUM BOXES, MANY SIZES IN STOCK
4 × 2 × 2in. **86p;** 3 × 2 × 1in. **65p;** 6 × 4 × 2in. **95p;** 8 × 6 × 3in. **£1.50;** 9 x 4 x 4in. **£1.70;** 6 x 4 x 4in. **£1.30.**

THE "INSTANT" BULK TAPE ERASER £4.95

Suitable for cassettes, and all sizes of tape reels. a.c. mains 200/240V. Post 50p
Leaflet S.A.E.

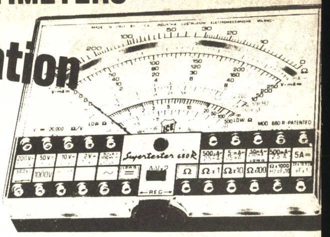
Head demagnetiser £4.75

RADIO COMPONENT SPECIALISTS 337 WHITEHORSE ROAD, CROYDON, U.K. Tel. 01-684 1665

Minimum post 30p. Access/Eurocard and Barclaycard/Visa. Same day despatch. Radio Books and Components Lists 20p. Open 9—6 Wed. 9—1 Sat. 9—5 (Closed for lunch 1.15—2.30)

I.C.E. MULTIMETERS

TWICE the information in HALF the size



The I.C.E. range of multimeters provide an unrivalled combination of maximum performance within minimum dimensions, at a truly low cost. Plus, a complete range of add-on accessories for more ranges, more functions.

Supertester 680R (illustrated)

- 20kΩ/V, ±1% fsd on d.c.
  4kΩ/V, ±2% fsd on a.c.
- 80 Ranges – 10 Functions
- 140 × 105 × 55mm

£32.00 + VAT
(For Mail Order add 80p P&P)

Supertester 680G

- 20kΩ/V, ±2% fsd on d.c.
  4kΩ/V, ±2% fsd on a.c.
- 48 Ranges – 10 Functions
- 109 × 113 × 37mm

£24.50 + VAT
(For Mail Order add 80p P&P)

Microtest 80

- 20kΩ/V, ± 2% fsd on d.
  4kΩ/V, ±2% fsd on a.c.
- 40 Ranges – 8 Functio
- Complete with case – only 93 × 95 × 23mm

£16.60 + VAT
(For Mail Order add 80p P&P)

All I.C.E. multimeters are supplied complete with unbreakable plastic carrying case, test leads, etc. and 50-plus page, fully detailed and illustrated Operating and Maintenance Manual.

Now available from selected stockists. Write or phone for list, or for details of direct mail-order service.

Electronic Brokers Ltd.
49-53 Pancras Road, London NW1 2QB
Tel: 01-837 7781

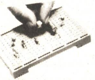
AITKEN BROS.

35, High Bridge, Newcastle upon Tyne

Tel: 0632 26729

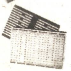
S/DEC

This, the most popular Board is designed solely for the use of discrete components and is particularly useful for basic educational purposes.
(No. of Contacts: 70) Complete with matching ZB5D Blob Board + 9 Project Booklet.
PRICE £3.75 inc. VAT.



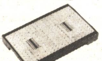
T-DEC

This Board allows 2 TO5 or 1 DIL IC Station to be used and so is primarily intended for discrete work or for linear IC application where considerable numbers of discrete components may be required.
(No. of Contacts: 208) Complete with matching ZB1 IC Blob Board + 4 Project Booklet.
PRICE £4.85 inc. VAT.



µ-DEC 'A'

The µ-Dec 'A' is specially designed for ease of use with IC's and allows 2 DIL or 4 TO5 stations to be used but will accommodate discrete components with equal facility.
(No. of Contacts: 208) Complete with matching ZB2 IC Blob Board + 4 Project Booklet.
PRICE £4.98 inc. VAT.



µ-DEC 'B'

The µ-DEC 'B' is for similar uses as µ-DEC 'A', but has two 16 lead IC sockets as part of the Board.
(No. of Contacts: 208) Complete with matching ZB2 IC Blob Board + 4 Project Booklet.
PRICE £7.75 inc. VAT.

PANEL METERS

Dims: 60mm × 45mm.
50µ amp, 100µ amp, 500µ amp. 1MA, 5MA, 10MA, 50MA, 100MA, 500MA. 1 amp, 2 amp, 25v dc, 30v dc, 50v ac, 300v ac, "S", "VU", 50-0-50µa, 100-0-100µa, 500-0-500µa.
PRICE £4.46 inc. VAT.

POTS* CAPACITORS, BOXES, INST. CASES, DIN PLUGS, RESISTORS, ETC., ALWAYS IN STOCK. POSTAGE AND PACKING 20p EXTRA.
CATALOGUE AVAILABLE. PLEASE SEND 75p.

ELTA Distribution Company

75 Willowtree Avenue
Gilesgate Moor
Durham DH1 1DZ
(0385) 62760 or 61765

		£
TRANSFORMERS		
240V 12V or 6-0-6V	200mA	0.98
220V 12V or 6-0-6V	200mA	0.88
240V 12V, 12V	both 250mA	1.95
240V 12V	2A	3.95
VOLTAGE REGULATORS		
LM342P 3 pin TO-202	200mA	
+5, +12, +24 please state		0.79
LM317MP 3 pin TO-202	500mA	
adjustable		1.48
RESISTORS		
⅓W 100R-10M (10,47,68 etc.)		0.02
ICs		
555 Timer 8dil		0.33
741 Op. amp 8dil		0.27
4001 Quad NOR 14dil		0.19
4011 Quad NAND 14dil		0.19
4013 Dual D F/F 14dil		0.56
4017 Decade counter 16dil		1.05
4026 Dec. count to 7seg 16dil		1.60
348 Quad 741 14dil		1.13
CSC BREADBOARD & TEST EQUIPMENT		
Experimentor 300		6.20
Experimentor 600 (MPU compat.)		6.55

Logic Monitor LM1			28.40
Logic Monitor LM2			66.55
Logic Probe LP1			30.55
Logic Probe LP2			18.10
Protoboard 100			11.95
Protoboard 6			9.45
Protoboard 203			53.65
Protoboard 203A			72.77
Digital Freq. Meter MAX 100			74.95
VEROBOX			
71 x 49 x 19mm			0.44
TRANSISTORS			
AC 126	0.40	BD 131	0.34
AC 127	0.40	BD 132	0.38
AC 128	0.40	BF 245A	0.24
BC 107	0.10	BFY 51	0.20
BC 108	0.10	BSY 95A	0.20
BC 109	0.10	2N2219	0.25
BC 109C	0.15	2N3055	0.50
BC 177	0.15	2N3702	0.11
BC 178	0.15	2N3704	0.12
BC 184	0.10	2N3706	0.12
BC 262	0.25	2N3819	0.25
BC 478	0.29	2N5459	0.32

CASH/CHEQUES/P.O.s/ACCESS/IMOs ACCEPTED. Telephone us with your access number for really FAST service.
POST/PACKING 25p UNLESS OTHERWISE STATED + VAT @ 8% (Except Export Orders)
TRADE, EDUCATION & EXPORT ORDERS WELCOME

A.	Good quality ribbon microphones and amplifiers DCB includes 1 4 pole c/o lever switch and 1 8 pole c/o lever switch and lamp, holder and reflector	**75p**
B.	Microswitch 5A	**8p**
C.	Smaller microswitch	**8p**
D.	Two-channel unit will provide 2 independent channels for telequipment servicescope	**SAE for details**
E.	Receiver capsules	**15p**
F.	Microphone capsules	**10p**
G.	Black Bakelite telephones	**£2.95**
H.	Handset only	**50p**
I.	Modern phones	**£6.95**
J.	Loudspeaking telephones	**£39.50**
K.	Dials	**£1.00**
L.	Coils	**15p**
M.	2 microfarad condensers	**10p**
N.	Ringers	**40p**
O.	Cable, wire	**per quote**
P.	Telephone Circuit boards	**50p**
Q.	Solid metal work benches – wired – crated	**£25.00**
R.	Radios, complete working without case	**£1.50**
S.	Quantity Power Transistors V17X 94	**Offers**

Seven day delivery. Write to or telephone for further details.

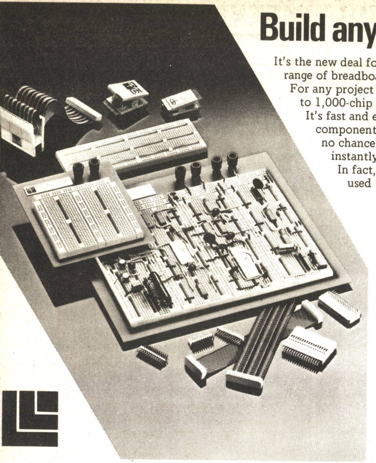
CONVERSATION PIECES (PE11), 55 Swindon Road,
Cheltenham, Glos. 0242 35707

Build any Project - Fast and Easy

It's the new deal for project builders from Lektrokit! A complete new range of breadboarding and testing devices. At prices anyone can afford. For any project anyone could want to build – from one-chip simplicity to 1,000-chip complexity.

It's fast and easy project building, too. You simply push components in and pull them out. No soldering, no de-soldering, no chance of heat damage. You can make design changes instantly, keeping full leads on components.

In fact, with Lektrokit, you can build a project as fast as you used to sketch a layout. And a lot more easily.



LEKTROKIT

completes the circuit

See Lektrokit at one of the Lektrokit dealers near you. There's bound to be one - they're springing up everywhere. Send for the name of your nearest – plus FREE full-colour catalogue – to:

Lektrokit Ltd., Sutton Industrial Park,
Earley, Reading, Berks RG6 1AZ
Telephone 0734 669 116

ELECTRONIC ENGINEERS

We are: A young energetic electronics company manufacturing patient monitoring equipment, utilising memory displays for E.C.G., blood pressure, temperature, etc.

We want: **Electronic Design Engineers** – Graduate standard, with knowledge of C-Mos Digital and Logic Circuitry, Operational Amplifiers and CRT Drive Amplifiers. Engineers will use their own initiative and previous experience to design circuits around technical requirements.

Test/Service Engineers – with good experience of fault finding associated with Digital and Analogue Circuitry, and for checking and repairing equipment as described above.

You receive: Good salaries – participation in bonus schemes – good working conditions and promotional prospects.

Apply: *In writing to the Personnel Manager,*
Albury Instruments Limited,
165 Dukes Road, London W3 0SL.

IT'S EASY WHEN YOU KNOW!

To avoid missing your copy of **PRACTICAL ELECTRONICS** – simply complete this order form and hand it to your newsagent.

ORDER FORM

To:..
(name of newsagent)
Address...
....
....

Please reserve/deliver every month one copy of **PRACTICAL ELECTRONICS** until further notice.

My Name...
Address...
....
....

PROGRESSIVE RADIO

93 DALE STREET, LIVERPOOL L2 2JD. Tel: 051-236-0982

SEMICONDUCTORS ALL FULL SPEC. BC212, BC182, BC237, BF197, BC159 all **8p** each. LM380 **80p,** LM381 **95p,** 741 8 PIN **23p,** 741S (wide bandwidth) 8 pin **35p.** TIL305 Alpha numerical display (with data) **£2·50p.** BX504 opto isolators infra red led to photo cell, 4 lead **25p,** BFY50 plastic **14p,** STC 3 volt 1 watt zener diodes **7p** each, BD533 **33p,** MRD3051 photo transistors **35p,** FETS similar to 2N3819 **18p,** MOSFET similar 40673 **35p.** Intel C1103 1024 bit mos rams **95p,** CD4051 **45p,** 723 14 pin I.C.'s. **35p.**

DIODES, BY127 **9p,** IN4002 **4p,** IN4005 **7p,** 600v 3 amp **17p,** Lucas bridge recs, 400v 1·5 amp **30p.** SPECIAL OFFER. TBA800 10 for **£5·00.** NE555 10 for **£3·00.**

MAN3A 3mm led displays **50p,** Min. Nixie 587 OST **75p.**

Pot core unit, has six pot cores including one FX2243 (45mm) and two FX2242 (35mm) 3 TO3 sil. power transistors on heat sink, 3-20mm panel fuseholders and panel with various transistors, diodes and a 5 amp plastic SCR, **£1·75p** plus 75p postage.

MOTORS, Model type 1·5–6 volts **20p,** 'BIG INCH' sub min motor 115 vac, 3 r.p.m. **25p.** 24 OVAC SYNCH. MOTORS WITH GEARBOX, 1/5 r.p.m. **75p,** 1/24th r.p.m. **75p,** 15 r.p.m. **£1·20p,** Crouzet 115 VAC 4 r.p.m. **95p,** 12v dc 5 pole **35p,** 12v 8 Track Cartridge Motors New **£1·25p.**

HI-SPEED MORSE KEY, ALL METAL **£2·25p.** PLASTIC MORSE KEYS, **95p.**

PLESSEY WINKLER SWITCHES, 1 pole 30 way, 2 bank adj. stop **75p.**

Crystal microphone inserts 37mm **45p,** Grundig electret condenser inserts with built in FET preamp **£1·50p,** ELECTRET PENCIL HAND MICROPHONES 1K IMP WITH STANDARD JACK PLUG **£2·85p,** TIE CLIP CONDENSER MIKES OMNI, 1K IMP, (uses deaf aid battery, supplied) **£4·95p.**

SOLDER SUCKER, high suction, eye protection shield **£4·95p.**

PROJECT BOXES, BLACK ABS PLASTIC WITH BRASS INSERTS AND LID, 75 × 56 × 35 **44p,** 95 × 71 × 35 **52p,** 115 × 95 × 36 **60p.**

BUZZERS, GPO open type 3-6v **30p.** Large plastic domed type loud note 6 or 12 volts **50p,** Solid State buzzers, miniature, 6-9-12-24 volt 15ma **75p** each.

TAPE HEADS, Mono Cassette **£1·30p.** Stereo cassette **£3·00,** BSR MNI330 half track dual imped. heads **£1·75p,** TD 10 Dual head assemblies 2 heads both $\frac{1}{4}$ track R/P with built in erase mounted on bracket, **£1·20p.**

Relays, Min 24v dc 2 pole c/o 3 amp contacts **55p,** Min sealed 220v ac 2 pole c/o **40p,** Open type 12v dc 4 pole c/o **50p,** 4 pole reed relays N/O **20p,** 240v 25LB pull 2" travel, large solenoid new **£3·95** + 54p. P.P.

CRYSTALS, 300khz **40p.** Aerosol 'Touch up' paint one colour yellow/grey, 6oz can **35p.** 50v ac cam units, motor switching ten c/o micro switches, supplied with capacitor for 240v ac use **£1·95p** plus 35p postage.

Belling Lee L4305 masthead amplifiers and mains power unit, new but only for group A UHF **£7·50p.**

TRANSFORMERS, 6-0-6v 100ma, 9-09 75ma, 12-012 50ma **75p** each, 12-012 100ma **95p,** 12v 500ma **95p,** 1:1 triac/xenon pulse transformers **30p,** CHOKES 6MC 3 Amp **20p.** U.H.F.TV Tuners, push button (not varicap) new and boxed **£2·50p.** Miniature toggle switches, SPST 8 × 5 × 7 **45p,** DPDT 8 × 7 × 7 **50p,** DPDT c/o 12 × 11 × 9 **75p,** Min. push to make or push to break 16 × 16mm **15p** each type. Slider switches, DPDT standard **15p,** Min. **12p,** Std. c/o **20p.** Roller action micro switches **15p.**

TOOLS Small side cutters 5" insulated handles **£1·35p.** Snub nosed pliers 5" insulated handles **£1·35p.** Board with 14 12 volt reed relays **£1·95p.** Large mains tester screwdrivers, fully insulated 8" **44p.** Test lead jumper sets, 10 leads with insulated croc clips each end, different colours **80p.** Telephone pick up coil, suction type with 3.5 mm jack plug **50p.** 9 volt battery eliminators, 240v ac input 9v dc out at 120 mA, stabilised replaced PP3, PP6, PP7, PP9 **£2·45p.** Edge connectors, 0·1 64 way **65p,** 34 way 4 op, 0·2 18 way **15p.** Murata MA401, 40KH2, Transducers Rec/Sender, **£3·25p** pair. Tape head demagnetisers, 240v ac with on/off switch, straight probe **£2·00,** curved probe (cassette) **£2·35p.**

TERMS: cash with order, (of official orders from colleges etc). Postage 30p unless otherwise shown, overseas post at cost. VAT inclusive prices S.A.E. for lists.

Progressive Radio, 31 Cheapside, Liverpool L2 2DY. Tel: 051-236-0982.

NOTICE TO READERS

When replying to Classified Advertisements please ensure:

- (A) That you have clearly stated your requirements.
- (B) That you have enclosed the right remittance.
- (C) That your name and address is written in block capitals, and
- (D) That your letter is correctly addressed to the advertiser.

This will assist advertisers in processing and despatching orders with the minimum of delay.

RECEIVERS AND COMPONENTS

MAINS TOUCH SWITCH kit 400 watt load capacity. Details free. I. G. Bowman, (Dept PE), 59 Fowey Avenue, Torquay, S. Devon.

TURN YOUR SURPLUS capacitors, transistors, etc., into cash. Contact COLES-HARDING & CO., 103 South Brink, Wisbech, Cambs, 0945-4188. Immediate settlement.

VALVES. Radio – T.V. – Industrial – Transmitting and Projector Lamps. We dispatch Valves to all parts of the world by return of post, Air or Sea mail, 4000 Types in stock, 1930 to 1976. Obsolete types a speciality. List **20p.** Quotation S.A.E. Open to callers Monday to Saturday 9.30 to 5.00 closed Wednesday 1.00. We wish to purchase all types of new and boxed Valves, Projector Lamps and Semiconductors. COX RADIO (SUSSEX) LTD., Dept. P.W. The Parade, East Wittering, Sussex, PO20 8BN, West Wittering 2023 (STD Code) 024366.

NICAD RECHARGEABLE CELLS, replacement sizes for penlite (AA size) **£1.20**, U11 (1.8AH) **£1.85**, U2 (4AH) **£2.25**. P&P 16p per cell. CWO to A. FRIDAY, 27 Batteries Close, Lynstead, Sittingbourne, Kent. (Postal Only).

MC6800P £8.90. MC6802P: improved 6800 MPU with clock and RAM **£13.60.** 6810 **£4.10.** 6820 *£4.95*. Static RAM boards: 1K × 8 **£21,20**: 4K × 8 **£62.60.** VAT, P&P included. Data sheets, 9p + SAE. JK ELECTRONICS, 11-15 Salters Lane North, Darlington, County Durham.

BRAND NEW COMPONENTS BY RETURN

Electrolytic Capacitors 16V, 25V, 50V. 0·47, 1·0, 2·2, 4·7 & 10 mfds. — **5p.** 22, 47—**5½p.** (50V—**6p**). 100—**7p.** (50V—**8p**). 220—**8p.** (50V—**10p**). 470—**11p.** (50V—**10p**). 1000/15V—**15p.** 1000/25V—**18p.** 1000/40V—**35p.**

Subminiature bead tantalum electrolytics. 0·1, 0·22, 0·47, 1·0 @ 35V, 4·7 @ 6.3V—**8p.** 2·2/35V & 4·7/25V—**9p.** 10/25V, 15/16V—**12p.** 22/16V, 33/10V, 47/6V, 68 & 100 @ 3V—**14p.**

Mullard Miniature Ceramic E12 Series 63V 2%. 10 pf. to 47 pf.—**3p.** 56 pf. to 330 pf.—**4p.**

Vertical Mounting Ceramic Plate Caps. 50V. E12 22 pf.—1000 pf. E6 1500 pf.—47000 pf.—**2p.**

Polystyrene E12 Series 63V. Hor. Mounting. 10 pf. to 1000 pf.—**3p.** 1200 pf. to 10000 pf.—**4p.**

Mullard Polyester 250V Vert. Mtg. E6 Series. ·01 to ·1—**4p.** ·15, ·22—**5p.** ·33, ·47—**8p.** ·68—**11p.** 1·0—**14p.** 1·5—**20p.** 2·2—**24p.**

Mylar (Polyester) Film 100V. Vertical Mtg. ·001, ·002, ·005—**3p.** ·01, ·02—**4p.** ·04, ·05—**5p.**

Miniature Film Resistors Highstab. E12 5%.

0.125 watt 10Ω to 2M2Ω .... **1p.**
0.250 watt 1Ω to 10MΩ (10% over 1M) .... **1p.**
0.500 watt 10Ω to 2M7Ω .... **1½p.**
1.000 watt 10Ω to 10MΩ .... **2p.**

1N4148—**3p.** 1N4002—**5p.** 1N4006—**7p.** 1N4007—**8p.**

BC107/8/9, BC147/8/9, BC157/8/9, BF194 & 7—**9p.**

20mm. fuses ·15, ·25, ·5, 1·0, 2·0, 3·0 & 5A—**3p.** Printed Circuit Holders for 20mm. fuses—**5p.**

Post 10p (Free over £4). Prices VAT inclusive.

THE C. R. SUPPLY CO.
127, Chesterfield Road, Sheffield S8 0RN

SMALL ADS

The prepaid rate for classified advertisements is 20 pence per word (minimum 12 words), box number 60p extra. Semi-display setting £6.60 per single column centimetre (minimum 2·5 cms). All cheques, postal orders etc., to be made payable to Practical Electronics and crossed "Lloyds Bank Ltd". Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Practical Electronics, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London, SE1 9LS. (Telephone 01-261 5846).

CONDITIONS OF ACCEPTANCE OF CLASSIFIED ADVERTISEMENTS

1. Advertisements are accepted subject to the conditions appearing on our current advertisement rate card and on the express understanding that the Advertiser warrants that the advertisement does not contravene any Act of Parliament nor is it an infringement of the British Code of Advertising Practice.
2. The publishers reserve the right to refuse or withdraw any advertisement.
3. Although every care is taken, the Publishers shall not be liable for clerical or printers' errors or their consequences.

P.C.Bs PAXOLIN 10½" × 4½" 4 – **£1.25.** 12" × 9" **70p.** 17½" × 9½" **£1.15.** D.S. 10" × 8½" **80p.** Fibre Glass D.S. 13" × 6" **£1.30.** 11½" × 7½" **£1.60.** Panel with 42 assorted 74 series ICs **£1.50.** 20 wire ended neons **£1.** 300 small components, trans, diodes **£1.50.** 7 lbs assorted components **£3.60.** 3½ lbs **£1.95.** List 15p. Refundable. Post 20p under £1. Insurance add 15p.

J.W.B. RADIO
2 Barnfield Crescent, Sale, Cheshire M33 1NL

BARGAINS FOR CONSTRUCTORS

CAPACITORS
ELECTROLYTIC (all values μf): 16V: 40, 47, 100, 220, 250, **8p**; 470, **10p**; 6.3V: 220, **6p**; 470, **8p**; 4V: 400, **6p. POLYESTER**: 250V: 0.003, 0.01, 0.1, **8p**; 0.22, 0.33, 0.47, **10p**; 2.2, **20p**. TANT 6V: 47, **15p** each.
VALUE CAPACITOR PACK: 100 mixed **£2.40.**
THERMISTOR: VA 1112, **15p** each.
TRANSISTORS: AC128, **12p**; BC148, BC158, BC170, BC172, BC252, BC261, **8p.**
DIODES: 3A 600V **10p**; 1A 600V **6p**; 80ma 150V **5p**; General purpose Silicon **5p**; Germanium (as OA91) **6p.** Zenner 400mw 12V, 13V, **5p.**
741 OP/AMP **18p.**
VALUE SEMICONDUCTOR PACK: 100 mixed **£2.50.**
BARGAIN PACK ASSORTED ITEMS: Caps, IC's, Transistors, Diodes etc. 200 items **£3.99.**

All devices are marked, some leads are cropped and formed, some have been assembled, but have been tested.
Prices include VAT, add 25p P&P.
Despatch by return of post. Full refund if not satisfied.

IMMEDIATE SERVICES
Tyne Road, Weedon Road Industrial Estate, Northampton

BRAND NEW FULL SPEC ONLY OPTO ELECTRONICS

L.E.Ds 5mm

Red 10 – **£1.00** Green 10 – **£1.60**
Yellow 10 – **£1.60** Clear (red light) 10 – **£1.30**
Pack 10 of each colour 40 – **£5.00**

SUPERIOR QUALITY AMERICAN MADE 15mm 4 DIGIT L.E.D. CLOCK DISPLAY COMMON/CATHODE. **£4.50**

ELECTRONIC KITS
0-35 volt, 3 amp, variable, power supply, S/C protected. P.C.B. & ALL PARTS, EX, TRANSFORMER **£6.50**
0-45 volt, 3.5 amp, variable, power supply, S.C.R. S/C protected. P.C.B. & ALL PARTS, EX, TRANSFORMER **£7.50**
32 L.E.D. V.U. DISPLAY (STEREO)
P.C.B. & ALL PARTS NEED 12-18 volt D.C. SUPPLY **£9.50**
FLUORESCENT INVERTER WILL RUN 4-40 watt TUBE H/F, VERY EFFICIENTLY **£2.50**

Terms – all prices VAT inclusive. C.W.O. – P.O. & Cheques payable FURAMA ELECTRONICS. P & P 25p

FURAMA ELECTRONICS
32/34 Scot Lane, Doncaster, Yorkshire DN1 1ES

LADDERS

LADDERS. Varnished 25½ft. Extd. **£34.56.** Carr. **£2.70.** Leaflet. Callers welcome. Open Sat. Ladder Centre, (PEE4) Halesfield (1) Telford, Salop. Tel: 586644.

WANTED

WANTED: Clean new semiconductors, I.C.'s etc. Good prices paid. Hewitts, 52 Barkby Road, Syston, Leicester.

ELECTRICAL

STYLI – illustrated equivalents (List 28) also cartridges, leads, etc. Superb quality and service at lowest prices: Fully guaranteed, Free for S.A.E. from FELSTEAD ELECTRONICS (PE), Longley Lane, Gatley, Cheadle, Cheshire SK8 4EE.

SERVICE SHEETS

BELL'S TELEVISION SERVICES for Service Sheets Radio, TV, etc. **75p** plus S.A.E. Colour TV Serv Manuals on request. S.A.E. with enquiries to B.T 190 Kings Road, Harrogate, N. Yorkshire, Tel: (04 55885.

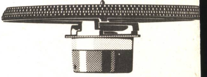
SERVICE SHEETS for Radio, Television, Tape Recorde Stereo etc. With free Fault-finding guide, from **50p** S.A.E. Catalogue **25p** and S.A.E. Hamilton Radio, Bohemia Road, St. Leonards, Sussex.

FOR SALE

MES STEREO DISCO, working but needs slight attenti complete with decks, microphone, 2 Goodmans 12 speakers. Reasonable offer secures. Grays Thurro (0375) 70993 after 6pm anytime weekends.

PRACTICAL ELECTRONICS Vols 1-10 in binders, Janua 1975–April 1976 loose; PRACTICAL WIRELE January 1972–April 1976 loose. Collect near Lond Heathrow. Offers Box No. 76.

BUILD YOUR OWN HIGH QUALITY TURNTABLE



Direct drive motor/die cast turntable pack - £25.00

Further details of these top quality components in return for s.a.e. - or personal callers welcome.

Add £2.50 for post & packing within UK and Eir
Ask for quote on export packing.

Symot Limited, 22a, Reading Road, Henley-on-Thames Oxfordshire. RG9 1AG. Telephone:(049-12) 2663.

OSCILLOSCOPE, Portable, Heathkit model 10-4540, 5 MH Less than latest kit price **£100.** Phone Leicester 864 84 evenings.

FOR SALE, Back issues of the following availabl 'PRACTICAL ELECTRONICS' June 1965 to Decemb 1975. 'WIRELESS WORLD' January 1972 to Decemb 1975. 'ELECTOR' December 1974 to December 1975. A **60p** each post free open P.O./Cheque returned if out stock. Jamieson Automatics Ltd., 1/5 Westgat Bridlington, N. Humberside.

ELECTRONIC KITS-SAE for new catalogue, and clearance li of obsolete kits. AMTRON U.K. 7 Hughenden Roa Hastings, Sx.

EN MY CAT? 5000 Odds and ends. Mechanical Electrical. at free. Whiston, Dept. PRE, New Mills, Stockport.

W BACK ISSUES of "PRACTICAL ELECTRONICS" available p each Post Free. Open P.O./Cheque returned if not in ock – Bell's Television Services, 190 Kings Road, arrogate, N. Yorks. Tel: (0423) 55885.

COLOUR MODULATOR

Kit
£6·95
Complete

FOR ALL TV GAMES!
● Red, Green & Blue inputs ● Switchable background colours ● *FREE* Interface details for tank battles — lifelike effects

WILLIAM STUART SYSTEMS
37, Billericay Road Herongate Brentwood Essex CM13 3SD
Telephone: Brentwood 810244

RE MEMORY PLANES, Ex-Equip. 4K (64 × 64) per plane p each + 25p P&P. Eight for **£7.50** Post Free. Langley, 31 Bakers Lane, Woodston, Peterborough.

UN YOUR OWN BUSINESS AS AN EXTRA HOME TIVITY. LARGE PROFITS. A GENUINE OPPORUNITY TO SUCCESS." Full details on receipt of .e. Industrial Supplies, 102 Parrswood Road, Withing-, Manchester 20.

DISCOUNT

Boxes, Instrument Cases, Components

Boxes from 44p. LM741c 8 pin dil I.C.S. Discounts up to 20%.

Send stamped self addressed envelope for pamphlet to **Harrison Bros., P.O. Box 55, Milton Road, Westcliffe-on-Sea, Essex SS0 7LQ.**

BOOKS AND PUBLICATIONS

END OF COMPUTER CONFUSION: what point have we ched – where are we going? Read Computer Lib/eam Machine by Ted Nelson. **£5.95** from your Local mputer Store, or send **£6.45** to Computer Bookshop, mple House (1), 43-48 New Street, Birmingham.

MPREHENSIVE TV REPAIR INSTRUCTIONS for your set 50 with circuit (if requested). Free catalogue unique V./other publications AUSE (PE) 76, Church Street, rkhall, Lanarkshire ML9 1HE.

EDUCATIONAL

COLOUR TV SERVICING

Learn the techniques of servicing Colour TV sets through new homestudy course approved by leading manufacturers. Covers principles, practice and alignment with numerous illustrations and diagrams. Other courses for radio and audio servicing. Full details from:

ICS SCHOOL OF ELECTRONICS
Dept. A272 Intertext House, London SW8 4UJ
Tel. 01-622 9911 (all hours)
State if under 18

TECHNICAL TRAINING

Get the training you need to move up into a higher paid job. Take the first step now—write or phone ICS for details of ICS specialist homestudy courses on Radio, TV, Audio Eng. and Servicing, Electronics, Computers: also self-build radio kits. Full details from:

ICS SCHOOL OF ELECTRONICS
Dept. A272 Intertext House, London SW8 4UJ
Tel. 01-622 9911 (all hours)
State if under 18

CITY & GUILDS EXAMS

Study for success with ICS. An ICS homestudy course will ensure that you pass your C. & G. exams. Special courses for: Telecoms. Technicians, Electrical Installations, Radio, TV & Electronics Technicians, Radio Amateurs. Full details from:

ICS SCHOOL OF ELECTRONICS
Dept. A272 Intertext House, London SW8 4UJ
Tel. 01-622 9911 (all hours)
State if under 18

TELEVISION TRAINING

18 MONTHS full-time course for beginners to include all the undermentioned subjects. Short courses, combining one or more subjects, for applicants with suitable education and electronics background such as C & G, HND, BSc etc.

- 13 WEEKS TECHNICAL MATHEMATICS & ENGLISH
- 13 WEEKS ELECTRONICS & RADIO
- 13 WEEKS MONOCHROME TELEVISION
- 13 WEEKS COLOUR TELEVISION
- 13 WEEKS VIDEO CASSETTE RECORDING & CCTV

The training incorporates a high percentage of practical work.

Next session starts on Jan 8th.

(Also available 2⅓ year course in Marine Electronics & Radar for employment as ships Radio Officer)

Prospectus from:

LONDON ELECTRONICS COLLEGE

Dept. PE, 20 Penywern Road,
London SW5 9SU. Tel. 01-373 8721

SITUATIONS VACANT

SOUTH OF SCOTLAND ELECTRICITY BOARD
INVERKIP POWER STATION

INSTRUMENT MECHANICS

SALARY	Up to £91.17 per week, plus Travel Allowance of up to £2 per week.
HOURS	5 cycle Shift Pattern or 7 day Stagger.
CONDITIONS	Superannuation Scheme: Sick Pay Scheme: Generous Holiday Entitlement.
HOUSING	May be available in appropriate circumstances: relocation expenses paid.
REQUIREMENTS	Applicants should have served recognised apprenticeship in appropriate skill and should have relevant experience.
TRAINING	Specialist/refresher training will be given in appropriate circumstances.
SECURITY	These posts are permanent and offer long-term security.
INTERVIEWS	To arrange an appointment for interview, Telephone Largs 675421, or write to the Station Manager, Inverkip Power Station, Inverkip, Greenock, Renfrewshire PA16 0ED

MISCELLANEOUS

PRINTED CIRCUIT BOARDS made to your requirements, write for details and price list. Western Circuit Designs, 31 Great Hinton, Trowbridge, Wilts. BA14 6BY.

HEXADECIMAL KEYBOARD. Encoded with Strobe **£17.50.** Kit **£15.00.** 20 Key Row and Column Type Suitable MK14 **£11.00.** Individual Keys including Blank **50p.** Sinclair Scientifics **£3.75.** MK14 Built and Tested **£58.00.** Write for details. LINTRONICS, 313 Green Lane, Ilford, Essex. MAIL ORDER ONLY.

CNC MILLING for those awkward panels or complicated 'Special' Heat Sinks or whatever – short or long runs. Please ring or send details of your requirements to:- DRURY BROS, Unit No.6, Headley Road, St. Albans, Herts. Phone 65094.

Resistors ¼W 5% 2R2-2M2 (E12). 10 each or more of each value **90p/100.** 100 assorted, our mixture **75p/100.** C60 cassettes in library cases **30p** each. Miniature relays 17 × 30 × 28mm 600Ω coil 4 sets change over contacts **50p** each. Prices include V.A.T. Add 10% postage.

SALOP ELECTRONICS
23 Wyle Cop, Shrewsbury.

PRINTED CIRCUIT BOARDS in glass fibre, drilled, tinned or varnished, from your own or published designs. S.A.E. for quotations. R. F. Darlison, 12 Whiteoaks Road, Oadby, Leicester.

CLEARING LABORATORY. Scopes, recorders, testmeters, bridges, audio, R.F. generators, turntables, tapeheads, stabilised P.S.U.s, sweep generators, test equipment, etc. Lower Beeding 236.

LOSING TIME?

MSF 60 KHz RECEIVER, built-in antenna, **£13.70,** or with parts (no case or pcb) for sequential YEAR, MONTH, DATE, DAY, HOURS, MINUTES, SECONDS display only **£24.40.**

SIG. GEN.? 10Hz-200KHz, sine/square, **£10.80.**

Each easy-assembly kit includes all parts, printed circuit, case, postage, etc., instructions, money back assurance so SEND off NOW. Overseas prices – irc.

CAMBRIDGE KITS
45 (FL) Old School Lane, Milton, Cambridge

NICKEL CADMIUM BATTERIES

Rechargeable and suitable for 'fast charge' **HP 7 (AA) £1.13, SUB C £1.47, HP 11 (C) £2.15, HP 2 (D) £3.27, PP3 £4.09, PP3** charger **£5.81.** All above Nickel Cadmium batteries are guaranteed 'EVER READY' full spec, and are supplied complete with solder tags (except PP3). Just in stock – New rechargeable sealed lead acid maintenance free batteries suitable for burglar alarms etc., 1.2 amp hr. 6v **£4.40,** 2.6 amp hr. 6v **£5.65.**
Quantity prices available on request. Data and charging circuits free on request with orders over £10 otherwise 30p post and handling (specify battery type), all prices include VAT. Please add 10% P&P on orders under £10. 5% over £10.

Cheques, postal orders, mail order to:

SOLID STATE SECURITY
DEPT PE, 10 BRADSHAW LANE,
PARBOLD, WIGAN, LANCS. 02575-4726.

Sound to Light Fantastic!

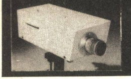
Videograph II links to the aerial socket of your tv and provides a full colour oscilloscope display! A must for hi-fi, home entertainment, discos, organs etc.

New — signal invert control, integral square wave generator. **Plus** — full details for testing your audio system for transient distortion, crosstalk etc.

Complete Kit only **£19·95** **Luxury cabinet and controls. £9·95**

INC. POST, PACKING, VAT. READY BUILT VIDEOGRAPH **£59.95**

WILLIAM STUART SYSTEMS Ltd
Dower House, Billericay Road,
Herongate, Brentwood,
Essex CM13 3SD.
Telephone: Brentwood (0277) 810244



BEST OFFER EVER £99·99 Total £110·64 inc p p & VAT **TV CAMERA**

Complete TV Camera Kit for under £100.00 (excluding P/P and VAT). Offer includes Lens, Tube and FREE Modulator. Plugs directly into AE socket of TV or VCR. Reliable high performance design. Suitable for Security, Education, Industry, etc. Fully compatible with other CCTV Equipment. Fully Guaranteed Parts. Buy it with your Credit Card.

CROFTON ELECTRONICS LIMITED
35 Grosvenor Road, Twickenham, Middlesex TW1 4AD. Tel: 01 891 1923

SUPERB INSTRUMENT CASES BY BAZELLI, manufactured from P.V.C. faced steel. Hundreds of people and industrial users are choosing the cases they require from our vast range. Competitive prices start at a low **90p**, chassis punching facilities at very competitive prices, 400 models to choose from, free literature (stamp would be appreciated). BAZELLI, Dept: No. 23, St. Wilfred's, Foundry Lane, Halton, Lancaster. LA2 6LT.

SINTEL FOR BOOKS, CMOS AND COMPONENTS

6800 Booklet **1.80**, MOT CMOS Databk **3.50**, 6800 Appl Man **12.95**, 6800 Prog Man **5.35**, SC/MP Introkit Man **0.75** NS TTL Databk **2.10**, RCA CMOS Databk **5.45**, 8085 User's Man **5.15**, Z80 Ass Lang Prog Man **7.50**, Z80 CPU Man **5.60**, Z80 CTC Spec **0.80**, Z80 P10 Man **3.30**. **Also a full range of CMOS** – *send for free catalogue.* **MPUs:** MEK6800D2 **205.20**, MC6820 **7.50**, Z80 **18.14**, Z80A **24.19**, Z80CTC **10.96**, Z80P10 **10.96**, Memories: 2102-A **2.00**, 2112A-4 **3.13**. **Displays:** Type FND500 C.C. **1.40**, Type TIL321 C.A. **1.40**, 5LTO1 **5.29**. **Crystals:** 32.768KHz **3.19**. **Clock ICs:** AY51202 **3.35**, AY51224 **3.73**, MK50253 **5.83**. **Soldercon Pins:** 100 **0.54**, 1000 **4.32**, 3000 **11.34**. **Free catalogue by return.** All items CWO. Prices inclusive of VAT. Add 35p p&p. **SINTEL, P.O. Box 75B, Chapel Street, Oxford. Tel. (0865) 49791.**

PRACTICAL ELECTRONICS P.C.B.'s
in glass fibre tinned and drilled
Dec. 77 Car Burglar Alarm 1412-1 **88p.**
May 78 Moving Light Display **£2.96.**
May 78 Workshop Power Supply **£1.97.**
May 78 Chorus Generator **£2.55.** July 78 Dimwit **£1.48.**
Aug 78 Digital Thermometer, two boards **£1.68.**
Aug 78 Touch Switch **85p.** C.W.O. Please.
For full list and current boards please send S.A.E. P.C.B.'s also produced from customer's own master – please send for quote.

PROTO DESIGN
14 Downham Road, Ramsden Heath, Billericay, Essex

CABINET FITTINGS
FOR
Stage Loudspeakers and Amplifier Cabs
Fretcloths, Coverings, Strap & Recess Handles, Feet, Castors, Jacks & Sockets, Cannons, Bulgin 8 ways, Reverb Trays, Locks & Hinges, Corners, Trim, Speaker Bolts etc.
Send 2 × 9p Stamps for samples and illustrated catalogue.

ADAM HALL (P.E. SUPPLIES)
Unit 3, Carlton Court, Grainger Road
Southend-on-Sea, Essex.

THE FABULOUS D2 MICROPROCESSOR EVALUATION KIT FROM MOTOROLA.

Featuring *24 key keyboard *Seven segment display *Cassette interface *Erom & Ram Expandable *Interface Capability *Full Documentation *5 Volt power supply Required *One years FREE membership of The Amateur Computer Club with every purchase*. **£176** + £1.50 P & P + 8% VAT.

ENAMELLED COPPER WIRE

SWG	1 lb	8 oz	4 oz	2 oz
10-19	2.60	1.40	.66	.55
20-29	2.80	1.60	.85	.65
30-34	3.00	1.70	.95	.70
35-40	3.35	1.90	1.10	.79
40-43	4.50	2.50	1.90	1.25
44-46	5.00	3.00	2.10	1.65
47	8.00	5.00	3.00	1.76
48	15.00	9.00	6.00	3.30

Tinned Copper, Even Gauges 14-30 £3 per lb.
Multicore 60/40 Solder 18SWG £3.24 per lb.
Prices include P & P and VAT.
SAE brings list of copper and resistance Wires.

THE SCIENTIFIC WIRE COMPANY
PO Box 30 London E.4.
Reg. Office, 22 Coningsby Gdns.

micron **RADIO CONTROL SPECIALISTS**
Kits for multi channel systems. Special parts and accessories.
S.A.E. FOR LEAFLETS
Tel: 0602 395418
MICRON R/C, Hayworth Road, Sandiacre, Nottingham.

DEAD or ALIVE OR JUST MIXED UP?
5-FUNCTION 13 AMP SOCKET TESTER
SAFELY SHOWS YOU!
Safety fast! Shows: 1, If all wires correct. 2, Live wire faulty. 3, Live and Neutral wires reversed. 4, Earth faulty. 5, Neutral faulty. Shows exact fault instantly. British made. £3.95 post free. Save time. Be sure. Be safe.

PERSONAL SAFETY CO.,
Dept. PE1, P.O. BOX 1,
LLANRWST,
GWYNEDD, NORTH WALES

MAKE YOUR OWN PRINTED CIRCUITS
Etch Resist Transfers – Starter pack (5 sheets, lines, pads, I.C. pads) **£1.30**. Large range of single sheets in stock at **27p** per sheet.
Ferric Chloride – 1lb bags **80p** (P&P 40p)*
Master Positive Transparencies from P.C. layouts in magazines by simple photographic process. Full instructions supplied. 2 sheets (20 x 25cm) negative paper and 2 sheets (18 x 24cm) positive film **£1.20.**
S.A.E. lists and information. P&P 20p/order except*

P.K.G. ELECTRONICS
OAK LODGE, TANSLEY, DERBYSHIRE

BELLS AND SIRENS
CARTERS SIREN **£5·53**
INDUSTRIAL SIX INCH
BELL **£8·27**
PRICES INCLUSIVE
Send Cheque, P.O. to:
CWAS ALARM
11 Denbrook Walk,
Bradford BD4 0QS.
6 to 12v D.C. SAE for full Price List of 12v D.C.
Professional Burglar Alarm Equipment

BUILD THE **TREASURE TRACER**
MK III Metal Locator

- Varicap tuning
- Britain's best selling metal locator kit
- Fitted with Faraday shield
- Speaker and earphone operation
- 4,000 already sold
- Prebulit search coil assembly
- Five transistor circuit
- Thoroughly professional finish
- You only need soldering iron, screwdriver, pliers and snips
- As seen on BBC-1 and BBC-2 TV

Send stamped, addressed envelope for leaflet

Complete Kit **£15·95** Post £1 20 + £1 37 VAT
Built and tested **£20·95** Post £1 20 + £1 77 VAT
MINIKITS ELECTRONICS, 6g CLEVELAND ROAD
LONDON E18 2AN (Mail Order Only)

MORSE CODE TUITION AIDS
Cassette A: 1–12 w.p.m. for amateur radio examination.
Cassette B: 12–24 w.p.m. for professional examination pr
paration.
Morse by light system available. Morse Key and Buzzer un
for sending practice.
Prices each cassette (including booklets) £4.50. Morse Ke
and Buzzer £4.50.
Prices include postage etc., Overseas Airmail £1.50 extra.

MHEL ELECTRONICS (Dept. PE)
12 Longshore Way, Milton,
Portsmouth P04 8LS.

PRINTED CIRCUITS and HARDWARE
Readily available supplies of Constructors' hardware. Printe
circuit boards, top quality for individual designs. Prom
service. Send 25p for catalogue. From:

RAMAR CONSTRUCTOR SERVICES,
Masons Road, Stratford upon Avon, Warwicks.
Tel. 4879.

NO LICENCE EXAMS NEEDED

To operate this miniature, solid-state **Transmitter-Receiver Kit.** Only **£9·75** plus 25p P. & P.
'Brain-Freeze' 'em with a MINI-STROBE Kit, pocket-sized 'lightning flashes', vari-speed, for discos and parties. A mere **£4·30** plus 20p P. & P. Experiment with a psychedelic DREAM LAB, or pick up faint speech/sounds with the BIG EAR sound-catcher; ready-made multi-function modules. **£5** each plus 20p P. & P.
LOTS MORE! Send 20p for lists. Prices include VAT. (Mail order U.K. only).

BOFFIN PROJECTS
Cunliffe Road, Stoneleigh
Ewell, Surrey (P.E.)

TRANSFORMER PROBLEMS?
Send SAE with requirements for return of post quote.

TRENT TRANSFORMERS LTD
26 Derby Road,
Long Eaton, Nottm. 06076 66716

NOTICE TO READERS

Whilst prices of goods shown in classified advertisements are correct at the time of closing for press, readers are advised to check with the advertiser both prices and availability of goods before ordering from non-current issues of the magazine

TRANSFORMERS

ALL EX-STOCK—SAME DAY DESPATCH. VAT 8%

12 OR 24 VOLT OR 12-0-12V

PRIMARY 220-240 VOLTS

ef	Amps 12V	Amps 24V	£	P & P
1	0·5	0·25	**2·20**	0·45
3	1·0	0·5	**2·64**	0·78
71	2	1	3.51	0·78
8	4	2	**4·03**	0·96
70	6	3	**5·35**	0·96
08	8	4	**6·98**	1·14
72	10	5	**7·67**	1·14
6	12	6	**8·99**	1·32
7	16	8	**10·39**	1·32
5	20	10	**13·18**	2·08
7	30	15	**17·05**	2·08
6	60	30	**26·82**	OA

50 VOLT RANGE

m 220/240V Sec 0-20-25-33-40-50V.
ltages available 5, 7, 8, 10, 13, 15, 17,
, 33, 40 or 20V-0-20V, 25V-0-25V.

ef	Amps	£	P & P
2	0·5	**3·41**	0·78
3	1·0	**4·57**	0·96
4	2·0	**6·98**	1·14
	3·0	**8·45**	1·32
6	4·0	**10·70**	1·50
7	6·0	**14·62**	1·64
8	8·0	**17·05**	2·08
9	10·0	**21·70**	OA

AINS ISOLATING (SCREENED)

M 120/240V SEC 120/240V CT TAPPED

ef	VA (Watts)	£	P & P
7•	20	**4·40**	0·79
9	60	**6·20**	0·96
0	100	**7·13**	1·14
1	200	**11·16**	1·50
2	250	**12·79**	1·84
3	350	**16·28**	1·84
4	500	**19·15**	2·15
5	750	**29·06**	OA
6	1000	**37·20**	OA
7	1500	**45·60**	OA
8	2000	**54·80**	OA
9	3000	**79·05**	OA

ase specify 115 or 240V required

HIGH VOLTAGE ISOLATORS

Prim 200/220V or 400/440V
Sec 110/120V CT or 200/240 CT

Ref	£	P & P
243	**5·89**	1·32
247	**14·11**	1·84
250	**41·76**	OA
252	**58·63**	OA

30 VOLT RANGE

Prim 220/240V Sec 0-12-15-20-24-30V. Voltages available 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24. 30V or 12V-0-12V, 15V-0-15V.

Ref	Amps	£	P & P
112	0·5	**2·64**	0·78
79	1·0	**3·57**	0·96
3	2·0	**5·27**	0·96
20	3·0	**6·20**	1·14
21	4·0	**7·44**	1·14
51	5·0	**8·37**	1·32
117	6·0	**9·92**	1·45
88	8·0	**11·73**	1·64
89	10·0	**13·33**	1·84

60 VOLT RANGE

Prim 220/240V Sec 0-24-30-40-48-60V. Voltages available 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60V or 24V-0-24V, or 30V-0-30V.

Ref	Amps	£	P & P
124	0·5	**3·88**	0·96
126	1·0	**5·58**	0·96
127	2·0	**7·60**	1·14
125	3·0	**10·54**	1·32
123	4·0	**12·23**	1·84
40	5·0	**13·95**	1·64
120	6·0	**15·66**	1·84
121	8·0	**20·15**	OA
122	10·0	**24·03**	OA
189	12·0	**27·13**	OA

AUTO TRANSFORMERS

Ref	VA (Watts)		£	P & P
113	15	0-115-210-240	**2·48**	0·71
64	75	0-115-210-240	**3·95**	0·96
4	150	0-115-200-220-240	**5·35**	0·96
67	500	0-115-200-220-240	**10·99**	1·64
84	1000	0-115-200-220-240	**18·76**	2·08
93	1500	0-115-200-220-240	**23·36**	OA
95	2000	0-115-200-220-240	**34·82**	OA
73	3000	0-115-200-220-240	**48·00**	OA
80S	4000	0-10-115-200-220-240	**67·50**	OA
57S	5000	0-10-115-200-220-240	**77·48**	OA

CASED AUTO TRANSFORMERS

240V cable in & 115V USA 2 pin outlet

VA	£	P & P	Ref
15	**4·96**	0·96	113W
75	**6·03**	1·14	64W
150	**8·48**	1·14	4W
200	**9·92**	1·45	65W
250	**10·49**	1·45	69W
500	**15·73**	1·64	67W
750	**18·55**	1·76	83W
1000	**23·50**	OA	84W
1500	**26·02**	OA	93W
2000	**37·65**	OA	95W

Our wide range of transformers are too numerous to list. Please call (open 9am-5pm Mon-Fri) or send your requirements. Electrosil & semiconductor stockists. Audio accessories.

SCREENED MINIATURES

Ref	mA	Volts	£	P&P
238	200	3-0-3	**1·99**	0·55
212	1A, 1A	0-6, 0-6	**2·85**	0·78
13	100	9-0-9	**2·14**	0·38
235	330, 330	0-9, 0-9	**1·99**	0·38
207	500, 500	0-8-9-, 0-8-9	**2·59**	0·71
208	1A, 1A	0-8-9, 0-8-9	**3·53**	0·78
236	200, 200	0-15, 0-15	**1·99**	0·38
214	300, 300	0-20, 0-20	**2·56**	0·78
221	700 (DC)	20-12-0-12-20	**3·41**	0·78
206	1A, 1A	0-15-20-0-15-20	**4·63**	0·96
203	500, 500	0-15-27-0-15-27	**3·99**	0·96
204	1A, 1A	0-15-27-0-15-27	**5·39**	0·96
239	50	12-0-12	**1·99**	0·38

MINI-MULTIMETER

DC-1000V AC-1000V DC-100mA Res-150kΩ 1000Ω/V Bargain **£6·14** P & P 62p VAT 8%

20,000 ohm/V Multimeter, mirror scale. Ranges AC/DC to 1000V, DC currents to 250mA. Resistance to 3 Megs. 5″ × 3½″ × 1¼″ **£14·36** P&P £1·05 VAT 8%.

TEST METERS

U4315 Budget Meter 20KΩ/V DC 2K/V AC 1000V AC/DC 2·5A AC/DC 500K res, in robust steel case and leads **£15·85.**

AVO8	**£80·70**	TT169 circuit transistor tester	**£33·75**
AVO71	**£32·50**	DA116 digital	**£100·00**
AVO73	**£44·20**	Megger BM7 Battery	**£44·15**
EM272	**£52·70**	Wee Megger	**£65·90**
MM5	**£27·66**		

P&P £1·15 VAT 8%.

Full range of AVO's, Megger's and Cases.

ISOLATOR – *Special Price*

0-200-220-240V, 0-240V Centre Tap, 250VA Ref. 62 **£5·20** P & P 96p

ISOLATOR 1KVA 240V to 240V enclosed. *Special Offer @* **£18·70.** Carriage £2·75.

ELECTRONIC CONSTRUCTION KIT

10 projects (including electronic organ). No soldering needed. **£7·29**. VAT 8% P & P 70p.

PANEL METERS

2″ 0-50μA	**5·50**	4″ 0-50μA	**6·70**	
0-500μA	**5·50**	0-500μA	**6·70**	Carriage
0-1mA	**5·50**	0-1mA	**8·40**	65p
0-30V	**5·50**	0-30V	**8·40**	VAT 8%

VU Ind Panel 90mm 250μa **£3·36**

VU Indicator Edge 54mm × 14mm μa 250μ FSD **£2·60**

Prices correct 17.8.78. Please add VAT after P. & P.
PE1

COMPONENT PACKS

65 High Quality Metal Oxide 2.5% ½w Resistors.
150 Mixed Value Capacitors
10 Read Switch.
30 Wire Wound Resistors, mixed.
25 assorted Presets.
50 Wire Wound Resistors, mixed.
washers, insulators. All **70p** each + 12½% P & P 40p.

12 way Grelco heavy black plastic terminal block **35p** P & P 15p.

Fuse holder 1¼″ completely enclosed **25p** P & P 15p.

2x Fuse boards – 2 with open 1¼ fuse holders 2¼″ × 3″ **30p** P & P 15p.

AMPLIFIER MODULES

10W	(AL30)	**£3·75**
25W	(AL60)	**£4·57**
35W	(AL80)	**£7·15**
125W	(AL250)	**£17·25**
Power Supply PS12		**£1·30**
Power Supply SPM80		**£4·25**
Pre-amp PA12		**£6·70**
PA100		**£13·88**

VAT 12½% P & P 35p

ABS Plastic Boxes inset brass nuts, slots to take PC cards, flush fitting lid.

PB1	80mm x 62 x 40	**56p**
PB2	100mm x 75 x 40	**63p**
PB3	120mm x 100 x 45	**70p**

P & P 29p, VAT 8%

Magnetic to Ceramic. Cartridge Convertor operating voltages 20-45V only **£3.50.** VAT 12½% P & P 35p.

NEW RANGE TRANSFORMERS

PM 0-120: 0-100-120 (120V or 220-240V).
Sec 0-36-48 twice

3A	**£14·70**	P & P £1·48
4A	**£18·77**	P & P £1·84
5A	**£26·64**	P & P £2·15

PLUG IN SAVE BATTERIES

MVA 30 – fits into 13A Skt. 6, 7·5, 9V 300mA multiplug outlet **£4·00.**
MVA 36 – 13A Skt. 3, 4·5, 6V @ 100mA multiplug outlet **£4·25.**
A122 – 3, 4·5, 6, 7·5, 9, 12V 500mA multiplug outlet **£9·21.**
VAT 12½% P & P 55p.

S-DECS

Solderless bread boarding

S Dec 70 contacts	**£1·98**
T Dec 208 contacts	**£4·35**
U Dec "A" for I.C.s etc	**£3·99**
U Dec "B" for I.C.s etc	**£6·99**

VAT 8% P & P 40p

ANTEX SOLDERING IRONS

15W **£3·75** Stand **£1·52**
25W **£3·95** + 12½% VAT
P & P 46p VAT 8%.

BRIDGE RECTIFIERS

50V	25A	**£2·00**
200V	2A	**£0·45**
400V	4A	**£0·85**
400V	6A	**£1·25**
500V	10A	**£2·85**

VAT 12½% P & P 15p VAT 8%

TRANSFORMERS

Special Offer

BE3 100V line to 4Ω 7/10W **£2·05** P & P 66p

BE4 0-120V × 2 (120V or 240) Screen sec 9-0-9V 1A **£2·40** P & P 71p

BE5 15W matching trans. sec 15Ω suit EL89 **£1·50** P & P 30p

BE6 PR1 0-220V sec 4500V 10 M A **£4.50** P & P £1.00

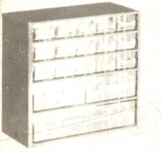
BE7 0-110-120 220V Pri 240V Sec 20V 1A **£1·50** 30p P & P.

Ref 30 240-240 Isolater 200VA **£4·20** P & P 96p.

Barrie Electronics Ltd.

3, THE MINORIES, LONDON EC3N 1BJ
TELEPHONE: 01-488 3316/7/8
NEAREST TUBE STATIONS: ALDGATE & LIVERPOOL ST

STORAGE CABINETS



Type 1118

Metal cabinets with transparent plastic drawers. Ideal for components, small parts, nuts, bolts etc. Many other uses in the home, workshop, laboratory etc.

Choose from the following range to suit your own needs:

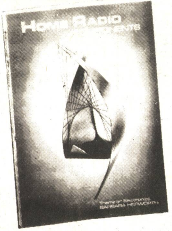
Type	Height (ins.)	No. of Drawers Total	Small	Medium	Large	Price
1118	11	18	15	2	1	**£8.65**
1130	11	30	30	–	–	**£8.95**
1633	16	33	30	2	1	**£10.95**
1150	18	50	50	–	–	**£12.95**
1860	22	60	60	–	–	**£14.95**

All cabinets are finished Blue, 12″ wide x 5¾″ deep. Prices include VAT and Post. Satisfaction or money refunded. Cheque/P.O. to:

MILLHILL SUPPLIES (TOOLS)

35 PRESTON CROWMARSH,
BENSON, OXON. OX9 6SL

THIS is the Catalogue you need to solve your component buying problems!



- The finest components catalogue yet published.
- 128 A-4-size pages.
- About 2,500 items clearly listed and indexed.
- Profusely illustrated.
- Bargain List sent free.
- At £1·25, incl. p. & p., the catalogue is a bargain.

Send the coupon below now.

HOME RADIO (Components) LTD. 234-240 London Road, Mitcham, Surrey CR4 3HD

POST THIS COUPON
with cheque or P.O. for £1·25

Please write your Name and Address in block capitals

NAME ____________________

ADDRESS ____________________

____

____

HOME RADIO (Components) LTD Dept PE
234-240 London Road, Mitcham, Surrey CR4 3HD

Regd. No.
912966 London

TTLs BY TEXAS

7400	13p
7401	14p
7402	14p
7403	14p
7404	17p
7405	18p
7406	32p
7407	32p
7408	19p
7409	19p
7410	15p
7411	24p
7412	20p
7413	30p
7414	60p
7416	27p
7417	27p
7420	17p
7421	40p
7422	22p
7423	34p
7425	30p
7426	40p
7427	34p
7428	36p
7430	17p
7432	30p
7433	40p
7437	35p
7438	35p
7440	17p
7441	70p
7442A	60p
7443	112p
7444	112p
7445	100p
7446A	93p
7447A	70p
7448	80p
7450	17p
7451	17p
7453	17p
7454	17p
7460	17p
7470	36p
7472	30p
7473	34p
7474	30p
7475	36p
7476	35p
7480	50p
7481	100p
7482	84p
7483A	90p
7484	100p
7485	110p
7486	34p
7489	210p
7490A	33p
7491	80p
7492A	46p
7493A	33p
7494	84p
7495A	70p
7496	35p
7497	180p
74100	130p
74104	65p
74105	65p
74107	34p
74109	55p
74110	55p
74111	70p
74116	200p
74118	130p
74119	210p
74120	110p
74121	28p
74122	48p
74123	55p
74125	55p
74126	60p
74128	75p
74132	75p
74136	75p
74141	70p
74142	200p
74145	90p
74147	190p
74148	150p
74150	100p
74151A	70p
74153	70p
74154	100p
74155	90p
74156	90p
74157	70p
74159	190p
74160	100p
74161	100p
74162	100p
74163	100p
74164	120p
74165	100p
74166	140p
74167	200p
74170	240p
74172	720p
74173	120p
74174	93p
74175	85p
74176	90p
74177	90p
74178	160p
74180	93p
74181	200p
74182	90p
74184A	150p
74185	150p
74186	700p
74190	100p
74191	100p
74192	100p
74193	100p
74194	100p
74195	95p
74196	95p
74197	80p
74198	150p
74199	150p
74221	160p
74251	140p
74259	250p
74265	90p
74278	290p
74279	140p
74283	190p
74284	400p
74285	400p
74290	150p
74293	150p
74294	200p
74298	200p
74365	150p
74366	150p
74367	150p
74368	150p
74390	200p
74393	200p
74490	225p

74LS SERIES

74LS00	22p
74LS02	22p
74LS04	22p
74LS08	22p
74LS10	24p
74LS13	45p
74LS14	100p
74LS20	22p
74LS22	28p
74LS27	38p
74LS30	22p
74LS47	90p
74LS55	30p
74LS73	50p
74LS74	40p
74LS75	50p
74LS83	110p
74LS85	100p
74LS86	40p
74LS90	90p
74LS93	90p
74LS107	45p
74LS112	100p
74LS123	75p
74LS124	180p
74LS132	120p
74LS133	60p
74LS138	60p
74LS139	60p
74LS151	100p
74LS153	60p
74LS157	60p
74LS158	120p
74LS160	130p
74LS161	100p
74LS162	140p
74LS163	120p
74LS164	120p
74LS165	80p
74LS173	110p
74LS174	110p
74LS175	110p
74LS181	320p
74LS190	100p
74LS191	100p
74LS192	140p
74LS193	140p
74LS195	140p
74LS196	120p
74LS221	100p
74LS240	245p
74LS241	245p
74LS242	245p
74LS243	245p
74LS245	300p
74LS251	200p
74LS257	120p
74LS259	175p
74LS298	249p
74LS373	200p
74LS374	195p
81LS95	120p
81LS96	160p
81LS97	120p
81LS98	160p
8T28	230p
9301	160p
9302	175p
9308	316p
9310	275p
9311	275p
9312	160p
9314	165p
9316	225p
9322	150p
9368	200p
9370	200p
9374	200p
9601	100p
9602	175p
9603	60p

INTERFACE ICs

MC1488	100p
MC1489	100p
75107	160p
75182	230p
75450	120p
75451/2	72p
75491/2	96p

C-MOS ICs

74C00	25p
74C02	25p
74C04	27p
74C08	27p
74C10	27p
74C14	90p
74C20	27p
74C30	27p
74C32	36p
74C42	110p
74C48	250p
74C73	75p
74C74	70p
74C85	200p
74C86	65p
74C90	95p
74C95	130p
74C107	125p
74C150	250p
74C151	260p
74C157	250p
74C160	155p
74C161	155p
74C162	155p
74C163	155p
74C164	120p
74C173	120p
74C174	160p
74C175	210p
74C192	150p
74C193	150p
74C194	220p
74C195	110p
74C221	175p

4000 SERIES

4000	15p
4001	17p
4002	17p
4006	95p
4007	18p
4008	80p
4009	40p
4010	50p
4011	17p
4012	18p
4013	50p
4014	84p
4015	84p
4016	45p
4017	80p
4018	89p
4019	45p
4020	100p
4021	110p
4022	100p
4023	22p
4024	65p
4025	20p
4026	130p
4027	50p
4028	84p
4029	100p
4030	55p
4031	200p
4033	180p
4034	200p
4035	110p
4040	100p
4041	80p
4042	80p
4043	90p
4044	90p
4046	130p
4047	100p
4048	55p
4049	40p
4050	49p
4051	80p
4052	80p
4053	80p
4055	125p
4056	135p
4059	600p
4060	115p
4063	120p
4066	55p
4068	22p
4069	20p
4070	30p
4071	22p
4072	22p
4073	22p
4075	22p
4076	107p
4081	22p
4082	22p
4093	80p
4098	107p
4411	1050p
4502	120p
4503	70p
4507	55p
4510	99p
4511	150p
4514	250p
4516	110p
4518	100p
4520	100p
4528	100p
4543	180p
4553	450p
4560	250p
4583	90p
4584	90p
40014	90p
40085	200p
40097	90p
14433	£11
SHIFT REG	
AM2833	400p

LINEAR ICs

*AY1-0212	600p
*AY1-1313	668p
*AY1-5050	212p
*AY5-1315	600p
*AY5-1317	636p
*AY5-1320	320p
*CA3019	80p
*CA3046	70p
*CA3048	225p
CA3080E	72p
*CA3089E	175p
*CA3090AQ	375p
CA3130S	100p
CA3140E	70p
CA3160E	100p
FX209	750p
ICL7106	925p
ICL8038	340p
LM301A	36p
LM311	190p
LM318	200p
LM324	70p
LM339	90p
LM348	95p
*LM377	175p
*LM380	75p
*LM381AN	150p
*LM389N	140p
LM709	36p
LM710	50p
LM733	100p
LM741	22p
LM747	70p
LM748	35p
LM3900	70p
LM3911	130p
LM4136	120p
*MC1310P	150p
MC1458	55p
MC1495	400p
*MC1496	100p
*MC3340	160p
*MC3360	120p
*MFC4000B	120p
MK50398	750p
NE531	130p
*NE540	200p
NE543K	225p
NE555	30p
NE556	70p
NE561B	425p
NE562B	425p
NE565	130p
NE566	155p
NE567	175p
*NE571	425p
RC4151	400p
*SN76003N	175p
*SN76013N	140p
*SN76013ND	120p
*SN76023N	140p
*SN76023ND	120p
*SN76033N	175p
*SP8515	750p
*TBA641B11	225p
*TBA800	90p
*TBA810	100p
*TBA820	90p
*TCA940	175p
*TDA1022	600p
*TDA2020	320p
XR2206	400p
XR2207	400p
*XR2216	675p
XR2240	400p
*ZN414	90p
ZN424E	135p
ZN425E	400p
ZN1034E	200p
95H90	800p

VOLTAGE REGULATORS Fixed Plastic TO-220

	+ve		−ve	
1A				
5V	7805	90p	7905	115p
12V	7812	90p	7912	115p
15V	7815	90p	7915	115p
18V	7818	90p	7918	115p
24V	7824	90p	7924	115p
100 mA TO-92				
5V	78L05	35p	79L05	80p
12V	78L12	35p	79L12	80p
15V	78L15	35p	79L15	80p

OTHER REGULATORS

LM309K	135p	TBA625B	120p
LM317T	200p	TL430	65p
LM323K	625p	78H05KC	675p
LM723	37p	78MGT2C	135p

OPTO-ELECTRONICS

2N5777	45p	ORP12	90p	ORP61	90p
OCP71	130p	ORP60	90p	TIL78	70p

0.125" LEDs 0.2"

TIL32 I.R.	75p	TIL220 Red	16p
TIL209 Red	13p	TIL222 Gr	18p
TIL211 Gr	20p	TIL228 Red	22p
TIL212 Ye	25p	MV5491 TS	120p
TIL216 Red	18p	Clips	3p

DISPLAYS

		FND357	120p
3015F	200p	FND500	120p
DL704	140p	FND507	120p
DL707 Red	140p	TIL311	600p
707 Gr	140p	TIL312/3	110p
DL747 Red	225p	TIL321/2	130p
747 Gr	225p	TIL330	140p

TRANSISTORS

AC127/8	20p
AD149	70p
AD161/2	45p
BC107/8	11p
BC109	11p
*BC147/8	9p
*BC149	10p
*BC157/8	10p
*BC159	11p
*BC169C	12p
*BC172	12p
BC177/8	17p
BC179	18p
*BC182/3	10p
*BC184	11p
BC187	30p
*BC212/3	11p
*BC214	12p
BC461	36p
BC477/8	30p
*BC516/7	50p
*BC547B	16p
*BC549C	18p
*BC557B	16p
*BC559C	18p
BCY70	18p
BCY71/2	22p
BD131/2	50p
*BD242	50p
BDY56	200p
BF200	32p
*BF244B	35p
*BF256B	70p
BF257/8	32p
BF259	36p
*BFR39	30p
*BFR40	30p
*BFR41	30p
*BFR79	30p
*BFR80	30p
*BFR81	30p
BFX29	30p
BFX30	34p
BFX84/5	30p
BFX86/7	30p
BFX88	30p
BFW10	90p
BFY50	22p
BFY51/2	22p
BFY56	33p
BFY90	90p
BLY83	700p
BRY39	45p
BSX19/20	20p
*BU105	190p
*BU108	250p
*BU205	220p
*BU208	200p
*BU406	145p
*E300	55p
*E308	60p
MJ481	175p
MJ491	200p
MJ2501	225p
MJ2955	100p
MJ3001	225p
*MJE340	65p
MJE2955	100p
MJE3055	70p
*MPF102	45p
*MPF103/4	40p
*MPF105/6	40p
*MPSA06	30p
*MPSA12	50p
*MPSA56	32p
*MPSU06	63p
*MPSU56	78p
OC28	130p
OC35	130p
*R2008B	200p
*R2010B	200p
*TIP29A	40p
*TIP29C	55p
*TIP30A	48p
*TIP30C	60p
TIP31A	58p
TIP31C	62p
TIP32A	68p
TIP32C	82p
TIP33A	90p
TIP33C	114p
TIP34A	115p
TIP34C	160p
TIP35A	225p
TIP35C	290p
TIP36A	270p
TIP36C	340p
TIP41A	65p
TIP41C	78p
TIP42A	70p
TIP42C	82p
TIP48	75p
TIP2955	78p
TIP3055	70p
*TIS43	34p
*ZTX108	12p
*ZTX300	13p
*ZTX500	15p
*ZTX502	18p
*ZTX504	30p
2N457A	250p
2N696	35p
2N697	25p
2N698	45p
2N706A	20p
2N708A	20p
2N918	45p
2N930	18p
2N1131/2	20p
2N1613	25p
2N1711	25p
2N2102	60p
2N2160	120p
2N2219A	20p
2N2222A	20p
2N2369A	16p
2N2484	30p
2N2646	50p
2N2904/5	25p
2N2906A	24p
2N2907A	30p
*2N2926	9p
2N3053	20p
2N3054	65p
2N3055	48p
2N3442	140p
2N3553	240p
*2N3565	30p
*2N3643/4	48p
*2N3663	30p
*2N3702/3	12p
*2N3704/5	12p
*2N3706/7	12p
*2N3708/9	12p
2N3773	300p
*2N3819	25p
*2N3820	50p
2N3823	70p
2N3866	90p
*2N3903/4	18p
*2N3905/6	20p
*2N4036	65p
*2N4058/9	12p
*2N4060	12p
*2N4061/2	18p
*2N4123/4	22p
*2N4125/6	22p
*2N4401/3	27p
2N4427	90p
*2N4871	60p
*2N5087	27p
*2N5089	27p
*2N5172	27p
2N5179	27p
2N5191	83p
2N5194	90p
*2N5245	40p
*2N5296	55p
*2N5401	50p
*2N5457/8	40p
*2N5459	40p
*2N5460	40p
*2N5485	44p
*2N6027	48p
2N6247	190p
2N6254	130p
2N6290	65p
2N6292	65p
3N128	120p
3N140	100p
3N201	110p
3N204	100p
40290	250p
40360	40p
40361/2	45p
40364	120p
40408	70p
40409	65p
40410	65p
40411	300p
40594	97p
40595	105p
40603	58p
40673	75p
40841	90p
40871/2	90p

MEMORIES

2102	100p
2102-2	125p
2107B	600p
2111-2	325p
2112-2	300p
2114	1500p
5101	510p
6810	400p

ROM/PROMs

74S188	225p
74S287	400p
74S387	400p
93427	400p
93436	650p
93446	650p
AY5-1013	450p
AY5-2376	1000p
R03-2513	600p
SN74S262	1450p
TMS6011	450p

EPROMS

1702A	500p
2708	900p
2716	3000p
4702	900p

CPUs

4040A	670p
6502	1200p
6800	900p
8080A	600p

OTHER

3205	320p
3245	400p
4201	390p
4289	970p
4801	500p
6820	600p
6850	700p
8205	320p
8212	225p
8216	225p
8224	400p
8228	575p
8251	700p
8255	550p
9905	200p
9906	275p

DIODES

*BY127	12p
*0A47	9p
*0A81	15p
*0A85	15p
*0A90	9p
*0A91	9p
*0A95	9p
*0A200	9p
*0A202	10p
*1N914	4p
*1N916	7p
*IS920	8p
*1N4148	4p
1N4001/2	5p
1N4003/4	6p
1N4005	6p
1N4006/7	7p
1N5401/3	14p
1N5404/7	19p

***ZENERS**
2.7V-33V

400 mW	9p
1W	15p

CRYSTALS

100 KHz	300p
1 MHz	370p
3.2768 MHz	350p

WIRE WRAP SOCKETS

14 pin	40p
16 pin	55p
24 pin	80p
28 pin	100p
40 pin	120p

PLEASE SEND SAE FOR FULL LIST.

KINDLY NOTE OUR NEW ADDRESS

BRIDGE RECTIFIERS
- *1A 50V
- *1A 100V
- *1A 400V
- *2A 50V
- *2A 100V
- *2A 400V
- *3A 200V
- *3A 600V
- *4A 100V
- *4A 400V
- 6A 50V
- 6A 100V
- 6A 400V
- 10A 400V
- 25A 400V

TRIACS PLASTIC
- 3A 400V
- 3A 500V
- 6A 400V
- 6A 500V
- 8A 400V
- 8A 500V
- 12A 400V
- 12A 500V
- 16A 400V
- 16A 500V
- T2700D
- T2800D

THYRISTORS
- 1A 50V
- 1A 400V
- 1A 600V
- 3A 400V
- 8A 600V
- 12A 400V
- 16A 100V
- 16A 400V
- 16A 600V
- BT106
- C106D
- *MCR101
- 2N3525
- 2N4444
- *2N5060
- *2N5064

LOW PROFILE DIL SOCKETS BY TEXAS

8 pin	11p	18 pin	25p	24 pin
14 pin	12p	20 pin	28p	28 pin
16 pin	13p	22 pin	30p	40 pin

SUBMINIATURE SWITCHES

Toggle		Push to make	
SPST	51p	(Red, green, yellow, black)	15p
SPDT	53p	Push to break	
DPDT	55p	(Only black)	35p

VAT RATES – All items at 8% except marked * which are at 12½%

96364 £14.

Please Add 25p p&p & VAT
Govt., Colleges, etc. Orders accepted
Callers Welcome } **Mon-Fri 9.30-5.30.**
Saturday 10.30-4.30

2 mins DOLLIS HILL Tube. Ample Car Parking.

TECHNOMATIC LTD
17 BURNLEY ROAD, LONDON NW1
Tel: 01-452 1500 Telex: 922800

INDEX TO ADVERTISERS

Ace Mailtronix Ltd ... 1178
Adam Hall (P.E. Supplies) ... 1206
Aitken Bros. ... 1202
Alben Engineering ... 1122
Albury Instruments Ltd. ... 1203
Alcon Instruments Ltd ... 1172
Astra-Pak ... 1122
Aura Sounds ... 1198

Barrie Electronics ... 1207
Bib Hi-Fi ... 1190
Bi-Pak ... 1132, 1133
Birkett J. ... 1172
Boffin Projects ... 1206
British National Radio & Electronics School ... 1135, 1189

Cambridge Kits ... 1205
Cambridge Learning ... 1123
Canon Components ... 1136
Chromasonic ... 1194
Clef Products ... 1124
Codespeed ... 1128
Component Centre, The ... 1200
Continental Specialties ... 1126, 1127
Conversation Pieces ... 1202
Crescent Radio Ltd ... 1184
Crimson Elektrik ... 1194
Crofton Electronics ... 1206
C.R. Supply Co. ... 1204
CWAS Alarm ... 1206

Delta Distributors ... 1202
Doram Electronics ... 1184, cover iii
Dziubas M ... 1190

E.D.A. ... 1195
Electronic Brokers ... 1202
Electrovalue Ltd ... 1183

Furama Electronics ... 1204

Gemini Electronics ... 1200
George Sales, David ... 1131
Goddard's Components ... 1192
Greenweld Electronics ... 1199

H.J.M. Scientific Engineering Ltd ... 1204
Harrison Bros. ... 1205
Harversons ... 1196
Heathkit Ltd ... 1172
Home Radio ... 1207

I.C.S. Intertext ... 1198, 1205
I.L.P. Electronics ... 1193

J.W.B. Radio ... 1204

K. & A. Distributors ... 1199

Lektrokit ... 1128, 1203
London Electronics College ... 1205
Lord, Jeremy ... 1199

Mantec Ltd ... 1195
Maplin Electronic Supplies ... cover iv
Marshall A. (London) Ltd ... 1197
MHEL Electronics ... 1206
Micron R/C ... 1206
Mill Hill Supplies ... 1207
Minikits Electronics ... 1206
Modern Book Co. ... 1136
Monolith ... 1199

Newnes (Butterworths) ... 1196

O.K. Machine & Tool (UK) Ltd ... 1136

P.B. Electronics ... 1122
P.K.G. Electronics ... 1206
Personal Safety Co. ... 1206
Phonosonics ... 1134, 1135
Progressive Radio ... 1203
Proto Design ... 1206

Radio Component Specialists ... 1201
Ramar Constructor Service ... 1206
R.S.T. Valve Mail Order ... 1194
Radio & T.V. Components ... 1191

Salop Electronics ... 1205
Saxon Entertainments ... 1130, 1131
Science of Cambridge ... 1171
Scientific Wire Co ... 1206
Sentinel Supply ... 1198
Service Trading ... 1177
Sintel Ltd ... 1206
Solid State Security ... 1205
Southern Transformers ... 1126
Squire, Roger ... 1178
Stirling Sound ... 1126
Sugden A. R. & Co ... 1178
Swanley Electronics ... 1196
Symot Ltd ... 1204

Technomatic Ltd ... 1208
Teleplay (Logic Leisure) ... cover ii
Tempus ... 1129
T.K. Electronics ... 1190
Trampus Electronics ... 1192
Trent Electronics ... 1206
Trident Exhibitions ... 1124
T.U.A.C. ... 1128

Vero Electronics ... 1124
Videotime Products ... 1184

W.A. Electronics ... 1195
Watford Electronics ... 1125
West London Direct Supplies ... 1124
William Stuart Systems ... 1205
Wilmslow Audio ... 1135
WKF Electronics ... 1200

V.D.U. SYSTEM
(as featured in current issue)

Author Approved Suppliers

Complete Kit **£49.0**
Ready-built tested Module **£69.0**
(Above prices include VAT and P & P)

Mains Power Supply Design supplied fr
of charge to above purchasers.

Troubleshooting provided on kits o
modules purchased from us (only by
appointment please).

P.C.B. **£6.00,** 2513 (single supply) **£6.0**
2102LF (Low Power, 350 nS) **£1.60**
81LS97 **£1.20.**

Please add VAT 8% and P & P 25p

TECHNOMATIC LTD
17 Burnley Road, London NW10
Tel: 01-452 1500

Published approximately on the 15th of each month by IPC Magazines Ltd., Westover House, West Quay Road, Poole, Dorset BH15 1JG. Printed in England by Chapel River Press, Andover, Ha
Sole Agents for Australia and New Zealand—Gordon & Gotch (A/sia) Ltd.; South Africa—Central News Agency Ltd.
Subscriptions INLAND and OVERSEAS £10.60 payable to IPC Services, Oakfield House, Perrymount Road, Haywards Heath, Sussex.
Practical Electronics is sold subject to the following conditions, namely, that it shall not, without the written consent of the Publishers first given, be lent, resold, hired out or otherwise disposed of by wa
Trade at more than the recommended selling price shown on the cover, excluding Eire where the selling price is subject to V.A.T., and that it shall not be lent, resold or hired out or otherwise disposed of
mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

DORAM
MODULAR AUDIO MIXER KITS
transcription
dynamic noise limiter kit (dnl)
phase locked loop stereo decoder kit

Just one of many kits in the New Hobbies catalogue

The new Doram Electronic Hobbies Catalogue is packed full of new exciting merchandise including

MICRO PROCESSOR BASED KITS.

ELECTRONIC KITS FOR ALL THE FAMILY

ELECTRONIC TOOLS AND BOOKS

AUDIO & CAR ACCESSORIES ETC.

For your Nights of Delight. Send for your copy now.

(AVAILABLE LATE SEPT)

Overseas customers (except for N. Ireland)—60p including despatch by Air (or all-up post).

Doram Electronics Ltd
P.O. Box TR8
Wellington Road Estate,
Wellington Bridge,
Leeds LS12 2UF

DORAM

ELECTRONIC HOBBIES CATALOGUE

Name...............................

Address...........................

....

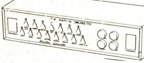
Please send my FREE Hobbies Catalogue. I enclose 25p. contribution to p. & p.

Doram Electronics Ltd
P.O. Box TR8
Wellington Road Estate,
Wellington Bridge,
Leeds LS12 2UF

PE7

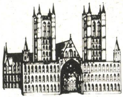
MAPLIN

everything for the modern D.I.Y. electronics enthusiast and mo



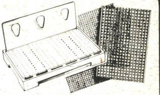
THE 'DRUMSETTE' RHYTHM GENERATOR

Organists, pianists, guitarists . . . an automatic drum set to accompany you! Nine highly realistic instruments play fifteen different rhythms. Fifteen rhythm-select touch switches and a touch plate for stop/start without rhythm change gives absolute ease of operation. Build it yourself for under **£65** including smart teak-effect cabinet. See it and hear it in our shop! Send for full construction details now: MES49 price **25p.** (All prices include V.A.T. and postage & packing).



REVERBERATION SYSTEMS

High quality spring line driver module uses 4 integrated circuits and two transistors. Built and tested circuit board with wiring instructions for spring line. XB85G, price **£6·00.** Power supply to suit driver module costs around **£2·50** and construction details are in catalogue, or ask for leaflet MES24. Mechanical spring lines: Short line (XL08J); **£4·49**; Long line (XB84F) **£10·39.** (All prices include V.A.T. and p & p.)



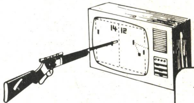
BOARDS AND PCB's

Pages 59 to 61 of our catalogue show you our range of Veroboards and S-Decs or if you prefer to make your own pcb's a range of etching systems including the novel etch-in-a-bag system, plus printed circuit transfers for the professional finish to your boards.

9-CHANNEL RADIO CONTROL SYSTEM

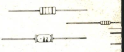
A comprehensive model control system, featuring nine independent fully proportional channels achieved by a design using very few components thus keeping the cost to a minimum. Full construction details in our booklet (XF03D) price **£1·20.**

All prices include V.A.T. and postage & packing.



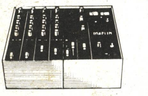
T.V. GAME

A fascinating TV game kit that plays football, tennis, squash and practice for only **£21·59.** Reprint of construction details **25p.** Add on rifle kit only **£10·60.** (All prices include V.A.T. and p&p).



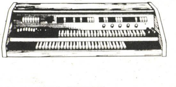
MASSIVE RANGE OF COMPONENTS

For instance the capacitor se in our catalogue includes polarised electrolytics and resistor section includes 1% tolerance types. Get fascinating catalogue now won't regret it.



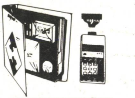
AUDIO MIXER

A superb stereo audio mixer. It can be equipped with up to 16 input modules of your choice and its performance matches that of the very best tape-recorders and hi-fi equipment. It meets the requirements of professional recording studios. FM radio stations, concert halls and theatres. Full construction details in our catalogue. A component schedule is available on request.



ELECTRONIC ORGAN

The only organ you can build in stages and tailor to your requirements as you go along—and at each stage you'll have a fully working instrument We haven't got the gimmicks yet—(they're coming soon) but we have got the most beautiful sounds—you won't find them on any organ less than twice our price. So get our MES50 series leaflets now! **65p** buys the three available so far.



MICROPROCESSOR

Build a mini-computer with our microprocessor kit. Features: 46 different instruction types: 256 bytes of read/write memory (more are easily added) microprocessor can address up to 65,536 8 bit-bytes. Complete kit for use with teletype etc (XB91Y) **£74·10.**
20-key keyboard for use with above (in place of teletype) (XB92A) **£71·11.** Both kits with detailed instruction books. See our newsletters for details of additional RAM's. tri-state interfacing chips, number-cruncher and standard cassette tape-recorder interface to store your programmes. (All prices include V.A.T. and p&p.)

Our bi-monthly newsletter keeps you up to date with latest guaranteed prices – our latest special offers – details of new projects and new lines. Send 30p for the next six issues (5p discount voucher with each copy).

Come and see all our projects on display at the Electronics hobby show 'Breadboard' at Seymour Hall, London W1
stands E7–E9.

POST THIS COUPON NOW FOR YOUR COPY 1979-80 CATALOGUE PRICE 75p

Please rush me a copy of your 216 page catalogu I enclose 75p, but understand that if I am not co satisfied I may return the catalogue to you within 14 days and have my 75p refund immediate

NAME

ADDRESS

MAPLIN ELECTRONIC SUPPLIES
P.O. BOX 3 RAYLEIGH ESSEX SS6 8LR
Telephone: Southend (0702) 715155
Shop: 284, London Road, Westcliff-on-Sea, Essex
(Closed on Monday. Telephone: Southend (0702) 715157